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NR. 3. P. JESPERSEN: ON THE FOOD OF THE HERRING IN ICELANDIC WATERS.

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ON THE FOOD OF THE HERRING IN ICELANDIC WATERS

BY

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I. Introduction.

The aim of the present paper will be to point out the most prominent features in the food biology of the herring in the waters round Iceland, the investigation in the first place trying to establish which organisms constitute the principal food matter of the herring. The investigation was exclusively based on analyses of stomach contents of the herring. It would have been the proper way of proceeding at the same time to have inquired into the problem of quantity and nature of the marine animal plankton constituting the chief food of the herring. But only in one year (1927) plankton samplings were made simultaneously with the herring fishing, and so in the present paper I shall be content to deal with the results of the inquiry into the stomach contents of the herring. In a later paper I shall hope in a near future to be able to produce a treatment of the plankton material which during these late years has been collected in the Icelandic waters.

The great herring fishing along the northern coasts of Iceland generally begins at the end of June or the beginning of July, the culmination mostly occurring at the close of July and in August. In most years the profitable herring fishery comes to an end in the latter half of August, but in some years it may be continued into the month of September. In the fjords, as e. g. in the Eyjafjord, the herring fishery is often continued far into the autumn, but generally the economic yield of this fishery is not very great.

By far the greater part of the material of herring stomachs constituting the basis of the present investigation has been collected at a time of the year when the great herring fishery is carried on along the coasts of the North. Hence, the results stated below principally concern the herring of this marine area and nearly exclusively the time from the end of June to the middle of September.

The literature in hand offers many facts as to the food of the Icelandic herring, but as yet there has been made no elaborate and detailed investigation into the relative importance of the different plankton organisms as food matter. One of the first authors to comment on the diet of the herring was no doubt Friedrich Faber who in 1829 gave the following information: "Fast nie findet man etwas in seinem Magen, doch zeigt sein Fett hinlänglich, dass er nicht vom Wasser lebt, wie mancher Fischer behauptet; auch sind mir Beispiele bekannt, dass kleine Crustaceen und andere Meerinsecten in seinem Magen gefunden worden sind." On the young herring, which he erroneously calls *Clupea sprattus*, he says that "seine Nahrung besteht in kleinen Insecten und Würmern". In 1906 Ove Paulsen published the result of some few stomach analyses where he points out *Calanus finmarchicus* as one of the most important food organisms of the Icelandic herring. In several publications (1908, 1926) Bjarni Sæmundsson has spoken in general on the food of the herring, and in other papers (1927, 1929, and 1931) he advances various observations on this problem. In the annual reports published during these late years by the Icelandic Herring Monopoly (P. A. Olafsson, 1929—32) are further given some stomach analyses together with information on the fat content of the herring, etc. Finally Arni Fridriksson in 1930 and 1932 wrote two papers touching on the problem of the food of the Icelandic herring. The former was worked up for the guidance of fishermen and especially deals with the various plankton organisms that make up the food of the herring, while in the latter there is rather a summary survey of the amount of food in herring taken in purse seine and drift net during the months of July and August, 1931.

For kind assistance in the accomplishment of this paper I am much indebted to the two Icelandic biologists, Dr. BJARNI SÆMUNDSSON and Mag. scient. ARNI FRIDRIKSSON. Further I beg to thank Mr. JON JOHANNESSON of the Siglufjord for his most valuable help in collecting herring stomachs for several years during the herring fishing at the northern coasts. Finally I offer my thanks to Mr. S. Goos, Director, for his great interest in the investigation, especially for his kindly putting a laboratory at our disposal at the Siglufjord.

II. Survey of the Material.

By far the greater part of the material constituting the basis of the present investigation dates from the years 1927, 1930, and 1931. During the herring fishings of these years stomachs were taken from a large number of fresh caught herring. Generally stomachs were taken from 10—20 herrings out of each catch. The material from 1927 was collected by the author himself when staying at Siglufjord during the herring fishing of the said year. The material from 1930 and 1931 was collected by Mr. JON JOHANNESSON in the Siglufjord, at the expense of the Plankton Laboratory. Further some material from the years 1923—26 and 1928—29 was examined, this portion, however, being considerably smaller than that of the said three years when more systematic collections were made. The material from 1929 was collected and examined by Mag. scient. ARNI FRIDRIKSSON during his stay at the Siglufjord; his method of investigation, however, differing somewhat from the one otherwise applied, the investigation of the said year has only occasionally been taken into consideration. Finally Dr. BJARNI SÆMUNDSSON has sent to the Plankton Laboratory the stomach contents of some herring from Icelandic waters, but as they were comparatively few in number and originated from several different localities, this material, too, was used only occasionally.

The total number of analyses of the stomach contents of herring from around Iceland amounts to about 4900, 3455 of which fall within the three years 1927, 1930, and 1931, when more systematic collections were made. The herring stomachs collected during these three years originate partly from herring taken in drift net, partly from herring taken in purse seine. The numbers of herring samples taken in the said years and of stomachs examined are distributed between the three years in the following way.

Table 1. Number of samples and of examinations of herring caught partly in purse seine, partly in drift net in the years 1927, 1930 and 1931.

	1927		1930		1931	
	No. of samples	No. of herring	No. of samples	No. of herring	No. of samples	No. of herring
Purse seine herring	40	764	58	726	39	546
Drift net herring	25	384	32	422	49	613

The two gears mentioned, purse seine and drift net, are the gears most commonly used, and these two methods of herring fishing are the only ones which are worked to any profit. In the fjords some herring are also caught in bar-nets and other gears, but the amount of these herring is quite negligible as compared with the catches in purse seines and drift nets. Apart from some few samples of herring taken in bar-nets the rest of the material dealt with in the present paper was caught in the two said gears.

The purse seine herring from which stomachs were taken originate from the waters along the whole of the northern coast of Iceland and from the fjords indenting the coasts from Huna Bay to Langanes. The bulk of the material of drift net herring, however, originates from the open sea from off Siglufjord to off

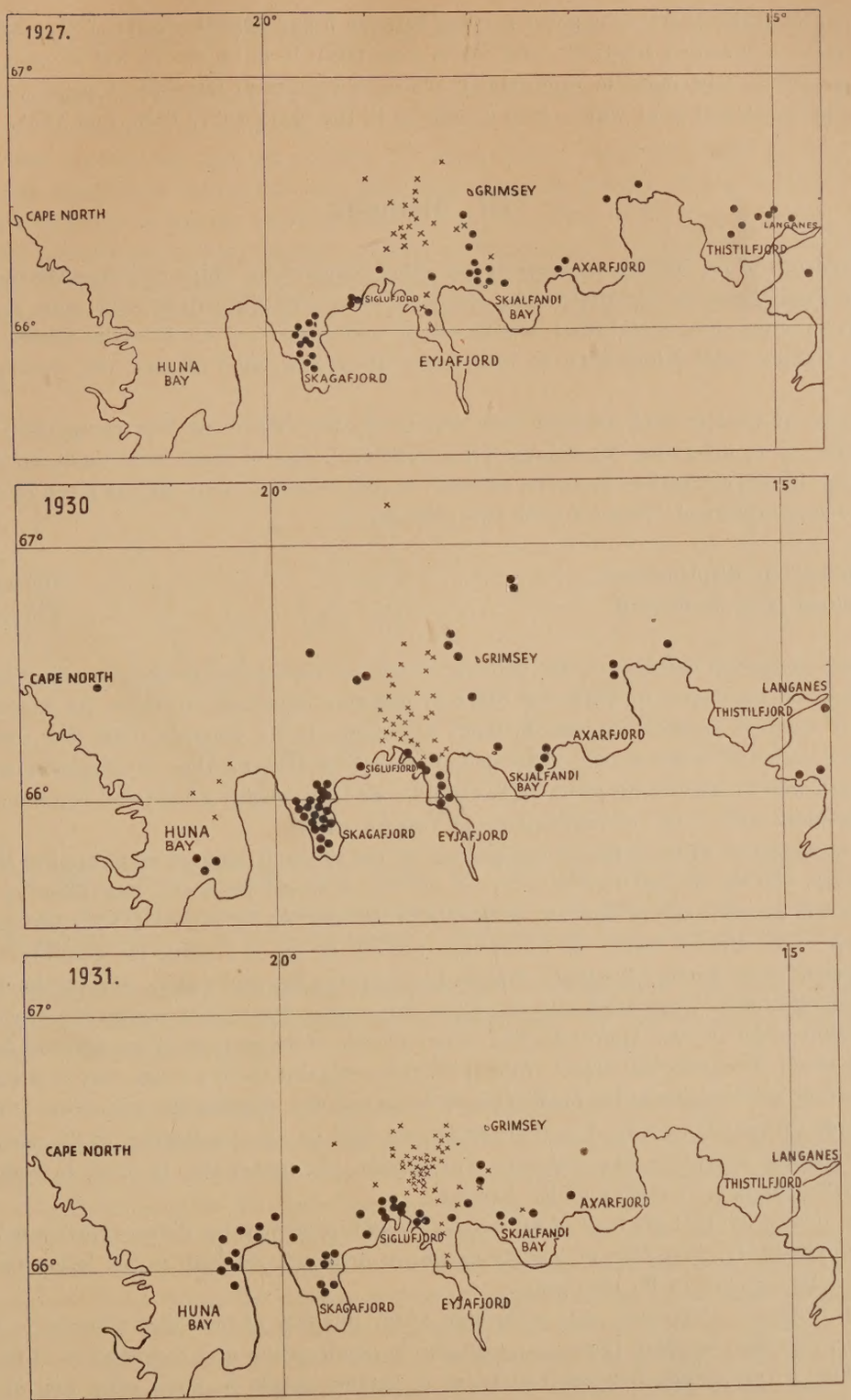

Fig. 1. Places of capture of respectively purse seine herring and drift net herring the stomachs of which were examined in the years 1927, 1930, and 1931. ● Purse seine herring. × Drift net herring.

Skjalfandi Bay, the distance from the shore ranging between 5 and 30 miles. Some few samples of drift net herring were taken still farther seawards, and others were taken in the fjords as will be seen from the three maps in Fig. 1. These maps show the approximate places of capture of respectively purse seine herring and drift net herring the stomachs of which were examined in the years 1927, 1930, and 1931.

III. Methods.

The stomachs of the herring were taken out either onboard the ships or immediately after they had come to port, generally in the Siglufjord. The stomachs from each individual catch were put into a small linen bag with a number on a metal label, and then they were preserved in a formalin solution. The number of the sample together with information on date, place of capture, kind of gear, etc., was taken down on special forms.

The volume of food in each stomach was measured after settlement. For comparison's sake it was considered sufficient to determine the volume after settlement, and so there were made no determinations by displacement. In this connexion, however, attention should be called to the figures given by SAVAGE (1931, p. 5) for the determination of volume by the two methods.

Volume by displacement	100 c.c.
Volume after settlement	276 c.c.

The latter method of determining the volume, which was used in the present investigation, is of course highly dependent on the degree to which the different plankton organisms do settle. An examination of the same sample of stomach contents by both methods has shown that a determination after settlement on an average shows a volume 3 times as big as the one attained in a determination by displacement. This result agrees pretty well with the statements given by SAVAGE. So we may roughly get the real volume of the stomach contents by dividing with 3 the determinations of volume stated.

In the investigation of the different components of the stomach contents were applied the usual symbols of frequency, viz. the designations rr, r, +, c, and cc. It would be nearly impossible to count up the different organisms as was done in the case of the North Sea herring by HARDY (1924) and SAVAGE (1931), and the herring of the Danish waters by JESPERSEN (1928). In the first place the quantity of food in the Icelandic herring is on an average far larger than in herring from the said waters, and on the other hand the food in the stomach is often compressed and decomposed to such a degree that in a great many cases it would be quite impossible to get an even approximately correct picture of the amount of the different food organisms found in the stomach. The principal object of the present investigation is in a rough way to make clear which organisms play a prominent part in the food of the herring, and so a detailed determination of the individual species was made exceptionally only. The main stress was laid on an investigation of the occurrence of the various groups of food organisms like copepods, euphausids, pteropods, etc., in order to demonstrate their relative importance as a food matter of the herring.

As it has turned out that the food of the herring caught in purse seine differs rather much, both quantitatively and qualitatively, from that of herring caught in drift net, we shall in the following make a distinction between the catches of the two gears.

We shall begin our statements with a mention of the quantity of food that is found in herring taken in the two gears, and then we shall proceed to examine in detail nature and composition of the food, at the same time making a comparison between conditions in herring caught in purse seine and of those caught in drift net.

IV. Quantitative Investigations of the Food of the Herring.

In the investigation of the food amount of the Icelandic herring was only used the material which was collected along the coasts of the North during the summer fishings of 1927, 1930, and 1931; for in these three years analyses were made of the stomach contents of a large number of herring caught partly in purse seine, partly in drift net. Continuous collections were only made from the middle of June to September, and so we shall content ourselves to use the material from this period, which is the proper season of the herring fishing. The total material of herring, the food amount of which was determined as to volume, amounts to 3385 individuals, 2016 of which are purse seine herring while 1369 are drift net herring. Within one sample the food amount of the individual herrings may vary considerably and in the same way the average volume

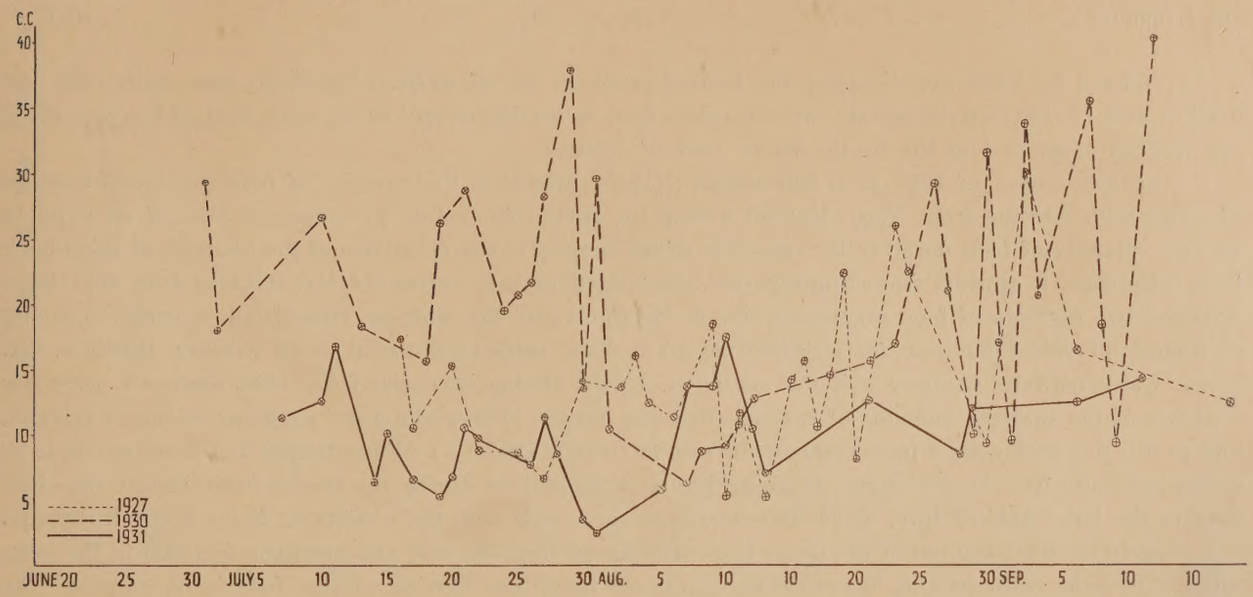

Fig. 2. Average volumes of food of *purse seine herring* from north of Iceland in the years 1927, 1930, and 1931. The graphs show the variations from day to day in the quantity of food during the season of the herring fishery.

of food within the different samples of herring is often subject to considerable variations. But generally there is a marked difference between the amount of food of purse seine herring and that of drift net herring, as will appear from a later section (p. 9).

1. Quantity of Food of Purse Seine Herring.

For the purpose of conveying an impression of the food amount of purse seine herring both through the fishing season of one year and for the three years as compared with each other, a graphic representation is given above (Fig. 2) showing the average volume per herring, the volumes being marked down on all days when investigations were made throughout the fishing season. If on the same day more than one sample of herring was examined, the average volume of the different samples from the said days was taken down.

The calculated mean figures for volume of food are highly varying: of the three years 1930 shows the largest average amount of food, especially at the beginning of the season, while the quantity of food in 1931 gives the smallest average figures of the three years of investigation. The graphs of the years 1927 and 1931 do not present very characteristic variations, whereas within a certain period of the year 1930, viz. from abt. Aug. 1st to Aug. 20th, the quantity of food in the stomachs of the herring was remarkably small.

The purse seine herring dealt with here being caught along the whole of the northern coast of Iceland, there would presumably be some difference in the quantity of food in the stomachs of herring from different localities. However, the material in hand does not enable us to demonstrate any very marked difference in this respect, but still the amount of food seems to be a little smaller in herring taken at the eastern than in herring taken at the western parts of the northern coasts. In this connexion it is of interest to quote some stomach analyses from 1924 of herring caught: 1. along the western coast of Iceland (off Havnarfjord), 2. along the northern country (Skaga- and Siglufjord), and 3. at the N.E. of the country (off Langanes) in the days of July 21st—28th.

Off Havnarfjord	56	herrings:	average	volume	of food:	10.9 c.c.
Skagafjord-Siglufjord	52	—	—	—	—	19.3 -
Off Langanes	50	—	—	—	—	10.8 -

Judging by these investigations the herring taken in the Skagafjord-Siglufjord area during the last third of July (1924) contains nearly twice as much food as herring caught at the same time of the year along the western coast and at the north-eastern part of Iceland.

In the summer of 1931 Arni Fridriksson (1932) examined the quantity of food in a great number of purse seine herring from North Iceland during the period from July 21st—August 31st. If we suppose that the quantity of food found in the stomachs of the herring is representative of the quantity of planktonic food organisms, it appears from Fridriksson's investigations that during the last third of July 1931 there occurred two maxima of food organisms, one in Eyjafjord and the other in Thistilfjord. During the month of August the said maximum for Eyjafjord seems to have shifted somewhat in an easterly direction, viz. to the water between Grimsey and the continent. In the present material from 1931 there are very few analyses of the stomach contents of herring from the eastern waters along the northern coasts of Iceland, and so it is but poorly fitted for a comparison with the results attained by Fridriksson, but there seems to be somewhat more food in the herring of Huna Bay and Skagafjord during the period from August 7th—12th than in the latter half of July, which thus seems to agree well with the conditions found by Fridriksson.

As to the food amount of the purse seine herring we note the very characteristic fact that in the large number of purse seine herring examined there was not found one herring without food in its stomach. The largest quantity of food found in a purse seine herring was met with in a herring caught in Skagafjord on Aug. 9th, 1927. When measured after settlement the volume of the stomach contents, which consisted nearly exclusively of copepods, was found to amount to 105 c.c., and by displacement it measured 35 c.c. However, this instance is quite exceptional, the volume — measured after settlement — but rarely exceeding abt. 50 c.c.

2. Quantity of Food of Drift Net Herring.

A distinctive feature of the drift net herring as opposed to the purse seine herring is the fact that sometimes we come across a rather great number of herring with no food in their stomachs. This problem, however, will be dealt with more closely in the comment on the food amount of respectively purse seine herring and drift net herring (*vide* pp. 9—13).

The average volumes of the food amount of drift net herring — calculated per date in the three years — appear from Fig. 3.

Investigations in the month of June were only made in the years 1930 and 1931, but it is a characteristic feature of both years that the stomach analyses from this month show quantities of food that are remarkably larger than from the other three months of investigation. The amount of food is especially small during the latter half of July and in August and September. For the year 1931 there is a slight rise in the amount of food from July to August. This agrees well with the results from the same year published by

Fridriksson (1932), who gives the following average volumes of the food of drift net herring: July 21st—31st, 0.7 c.c.; August 1st—10th, 2.3 c.c.; August 11th—20th, 3.3 c.c.; and August 21st—31st, 3.8 c.c.

A comparison between the graphs of 1930 and 1931 will show that the quantity of food in June and July was considerably larger in 1930 than in the corresponding months of 1931. As mentioned above quite the same conditions asserted themselves in the case of the food amount of purse seine herring of the same two years.

The graphs representing the food amount of drift net herring seem to indicate that the volume of the stomach content decreases in the course of the autumn, and by the kindness of Dr. Bjarni Sæmundsson I have got various information showing that at any rate sometimes in the autumn the stomach of the herring

Fig. 3. Average volumes of food of *drift net herring* from north of Iceland in the years 1927, 1930, and 1931. The graphs show the variations from day to day in the quantity of food during the season of the herring fishery.

from the northern coasts of Iceland is practically empty of food. Dr. Sæmundsson examined a sample of 20 herrings caught in Siglufjord on Nov. 11th, 1928. 16 of them were without food of any kind and 4 contained only very small remnants of food organisms. Further, in a letter to Dr. Sæmundsson, Mr. Jon Johannesson says that in herring caught in Siglufjord in late November of the same year no food at all was to be found and that the herring had lately become very lean.

3. Difference between the Quantity of Food of Purse Seine Herring and Drift Net Herring.

In this section we are going to demonstrate the difference generally found between the quantity of food in the stomachs of herring caught in purse seine and of those caught in drift net, and here, too, we shall content ourselves with using the material of herring stomachs collected along the coasts of the North in the years 1927, 1930, and 1931.

In order not to complicate matters too much we shall divide the material into different groups, each comprising the material of a period of 10 days. If we calculate the average volume of the stomach content

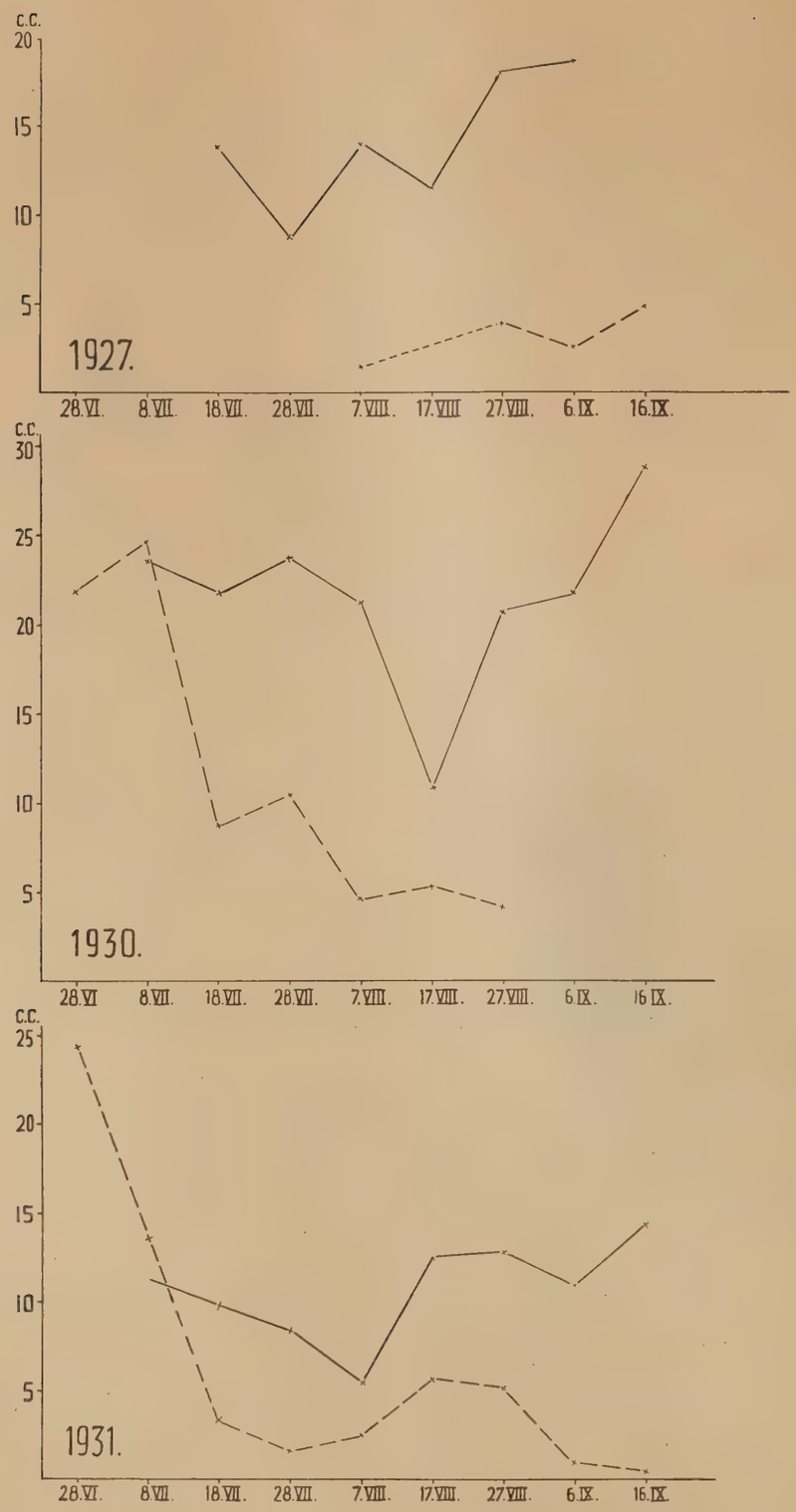

Fig. 4. Average volumes of stomach content for each 10 days' period in 1927, 1930, and 1931.
———— purse seine herring. — — — drift net herring.

of purse seine herring and drift net herring within such 10 days' periods, we get the following average values for the three years. (Table 2).

For the purpose of further illustrating the proportion between volume of stomach content of purse seine herring and of drift net herring, the quantities given in the table are represented graphically in Fig. 4.

Table 2. Average volumes of stomach content of purse seine herring and drift net herring for each 10 days' period in 1927, 1930, and 1931.

		19. VI—28. VI	29. VI—8. VII	9. VII—18. VII	19. VII—28. VII	29. VII—7. VIII	8. VIII—17. VIII	18. VIII—27. VIII	28. VIII—6. IX	7. IX—16. IX
1927	Purse seine herring	—	—	13.9	8.8	13.5	11.4	18.0	18.6	—
	Drift net herring	—	—	—	—	1.3	—	3.9	2.4	4.8
1930	Purse seine herring	—	23.6	21.8	23.8	21.2	10.9	20.7	21.7	28.8
	Drift net herring	21.9	24.8	8.7	10.5	4.6	5.3	4.1	—	—
1931	Purse seine herring	—	11.2	9.8	8.4	5.4	12.5	12.8	11.0	14.3
	Drift net herring	24.2	13.5	3.7	1.7	2.5	5.7	5.1	1.0	0.5

It appears from the figure that apart from the period from the latter half of June to the beginning of July when very considerable quantities of food were found in drift net herring both in 1930 and 1931, the time from the middle of July to the middle of September of all three years shows by far a smaller stomach content of drift net herring than of purse seine herring. If on the basis of the above mentioned quantities for the three years we calculate the average volumes for the 10 days' periods from July 9th to September 16th, we get the following mean figures:

	9. VII—18. VII	19. VII—28. VII	29. VII—7. VIII	8. VIII—17. VIII	18. VIII—27. VIII	28. VIII—6. IX	7. IX—16. IX
Purse seine herring	15.2	16.1	13.4	11.6	17.2	17.1	21.5
Drift net herring	6.2	6.1	2.8	5.5	4.4	1.7	2.6

In all these decades the quantity of food in the purse seine herring is more than twice as large as in the drift net herring, and in several of the 10 days' periods the volume of the stomach content of purse seine herring is even several times the size of that of drift net herring.

Talking about the quantity of food in herring caught in the two gears it should further be mentioned that purse seine herring with empty stomachs were never met with, whereas the occurrence of drift net herring without food in their stomachs is not very infrequent. A survey of herring with no stomach contents from the years 1927, 1930, and 1931 is given below.

	Purse seine herring			Drift net herring		
	No. of stomachs examined	Number of empty stomachs	Percentage of empty stomachs	No. of stomachs examined	Number of empty stomachs	Percentage of empty stomachs
1927	744	0	0	346	43	12.4
1930	726	0	0	410	16	3.9
1931	546	0	0	613	54	8.8

During the three years was found a total of 113 drift net herrings with empty stomachs, which makes up 8.3 per cent. of the total number of drift net herring examined.

Now the question will suggest itself: what is the reason that in most cases herring caught in the purse seine contain much more food than those caught in the drift net? — It has already been mentioned and further it appears from the maps of the places where collections were made (p. 5) that the purse seine herring and drift net herring examined originate from rather different places along the coasts of Northern Iceland. The purse seine herring were taken in places distributed all along the northern country and in the fjords indenting the coast from Huna Bay to Thistilfjord, whereas the bulk of the drift net herring examined originate from the open sea, from off Skagafjord to off Skjalfandi Bay at distances from the shore ranging between 5 and 30 miles. The explanation naturally suggests itself that the smaller quantities of food in the stomachs of drift net herring are due to the fact that on the whole these herring are caught farther seawards. Possibly, too, this is of some importance, but in itself it will not explain the fact that the food amount — and what will appear later on: nature and composition of the food — of purse seine herring is so different from that of drift net herring.

Comparatively few samples of purse seine herring were taken in the open sea within the area where the drift net fishery generally takes place, but from the days of August 17th—19th, 1927, we have three samples of purse seine herring taken in the water between Grimsey and the continent, and so it is interesting to compare the volume of their stomach content with that of some drift net herring (7 samples) caught on the said days and within the same area. The comparison is made below, the figures giving the average volumes of stomach content of the respective samples of purse seine herring and drift net herring.

Purse seine herring.....	8.9, 18.9, 22.2.	Average: 16.7 c.c.
Drift net herring.....	2.5, 2.6, 3.7, 3.8, 4.8, 8.7, 10.2.	Average: 5.2 c.c.

It is seen that although these herring were caught within the same area and at the same time, the volume of the stomach content of the purse seine herring is on an average three times as great as that of the drift net herring.

Accordingly, it appears from the above instance that on the whole purse seine herring contain much more food than drift net herring caught in the same waters. So the cause of the different volumes of food should rather be sought for in the fact that the bulk of the herring caught in purse seine and drift net, respectively, have been living in somewhat different water layers where there is a varying amount of the food organisms of the herring.

On the whole it may be said that the purse seine will principally catch the herring going in the upper water layers and immediately below the surface, whereas the drift net herring are caught in somewhat deeper water, the nets trailing at a certain depth below the surface. Now it should be kept in mind that the purse seine fishing at Northern Iceland depends exclusively on the herring shoals that are discovered from the boat in the very surface of the water. From Mr. Jon Johannesson, Siglufjord, I have got various information about the depths at which the two gears generally fish. The depth of the purse seine being in most cases from 40 to 60 m. it will principally take herring at depths ranging from abt. 50 m. to the surface, while the drift nets are generally trailing at depths of 16—20 m. below the surface, and so they will only catch the herring going from this depth and down to 28—34 m. None of the herring that are going higher than at depths of 16—20 m. below surface will therefore strike the drift net but are exclusively taken in the purse seine.

Now the quantity of zoo-plankton along the coasts of Northern Iceland is in summer generally far greater in the upper water layers than in deeper water. This appears from the below table which shows volumes of plankton at different depths at a series of stations worked from the "Dana" in July 1926, in the water N. of Iceland from off Eyjafjord to Huna Bay. The plankton samplings were made in vertical hauls with a standard net (coarse-meshed silk no. 3) at depths of 10—0, 25—10, and 50—25 m.

As a rule the greatest quantities of plankton per m. were taken in the upper water layers, viz. from

10 m. to the surface. In a few cases the greatest volumes were taken at depths of 25—10 m., but at no stations was the maximum volume found at depths of 50—25 m. If we calculate the average volumes of plankton per m. for the three depths, we get the results: 10—0 m.: 0.23 c.c., 25—10 m.: 0.15 c.c., 50—25 m.: 0.05 c.c. In other words: at depths of 25—10 m. was taken three times as much plankton as at depths of 50—25 m., and in the upper water layers abt. 4.5 times as much as in the water layers from 50 to 25 m.

Table 3. Volumes in c.c. of plankton from vertical hauls of 12 stations in the waters N. of Iceland in July, 1926.

St. Nr.	Date 1926	Position		10—0 m.		25—10 m.		50—25 m.	
		Lat. N.	Long. W.	Volume	Volume per meter	Volume	Volume per meter	Volume	Volume per meter
2706	6. VII	66°23′	21°31′	1.0	0.10	1.1	0.07	1.5	0.06
2707	—	66°17′	20°16′	1.8	0.18	0.4	0.02	0.1	0.01
2712	—	66°13′	19°18′	0.6	0.06	0.9	0.06	0.9	0.03
2716	8. VII	66°24′	18°50′	0.3	0.03	2.0	0.13	2.3	0.09
2761	11. VII	65°53′	20°26′	5.4	0.54	2.4	0.16	1.3	0.05
2775	14. VII	66°23′	21°31′	1.3	0.13	1.4	0.09	1.6	0.06
2779	—	66°30′	20°04′	1.7	0.17	1.4	0.09	0.1	0.01
2840	20. VII	66°11′	19°07′	6.0	0.60	6.5	0.43	1.9	0.07
2889	25. VII	65°58′	21°12′	2.3	0.23	0.3	0.02	0.5	0.02
2903	26. VII	66°32′	18°50′	5.0	0.50	2.9	0.19	1.4	0.05
2915	28. VII	66°16′	18°50′	2.3	0.23	0.9	0.06	0.2	0.01
2917	—	66°24′	18°50′	0.5	0.05	8.0	0.53	4.5	0.18

Thus we find the greatest amount of plankton in the upper water layers, and at any rate the bulk of the purse seine herring are caught comparatively near the surface. Then it is an obvious conclusion that the stomachs of the purse seine herring containing comparatively much food must be due to the fact that the herring taken in this gear have at most times lived in water layers with an especially rich plankton fauna. Then the smaller amount of food in drift net herring would be caused by their being caught in somewhat deeper water where food organisms occur in comparatively smaller quantities.

4. Quantity of Food in the Herring Stomachs and Catch Yield of Herring.

In our comment on the diet of purse seine herring we saw that its average volume in 1931 was smaller than in 1927 and 1930, and more especially there was a considerable difference between 1931 and 1930. As no collections of plankton were made in these years, it is impossible to say whether the amount of plankton in the waters N. of Iceland were larger in 1930 than in 1931. For the North Sea, however, (see HARDY 1926, pp. 9—11 and SAVAGE 1931, pp. 44—47) a certain connexion has been demonstrated between the quantity of plankton and the food amount in the herring stomachs, and so the suggestion is obvious that the amount of herring found in the different years at the coasts of Northern Iceland changes according to the greater or smaller amount of plankton which is found in the sea in the respective years. It should be remembered that the herring found at Northern Iceland in summer only stay in these waters for the sake of feeding as it is a well-known fact that the Icelandic herring will only spawn in the warmer waters along the southern and western coast of the country (see i. a. SCHMIDT, 1904, JESPERSEN, 1920 and JOHANSEN, 1921).

On account of lacking collections of plankton it is thus impossible to compare the quantity of food in the herring stomachs with the quantity of plankton in the different years, but some dates are available concerning the catch yield of herring, so that a comparison can be made between the food amount in the herring

stomachs and the size of the catches. In the years 1930 and 1931 Mr. Jon Johannesson, Siglufjord, who collected the herring stomachs, has taken down the catches per day of the herring-boats from the catches of which the stomachs were taken for the investigation. Therefore we are able to compare the catch yield of the different days with the volume of the stomach content of the herring. As already mentioned the year 1930 showed great fluctuations in the food amount of the herring that was caught in purse seine, and so we will compare the average volume of the stomach content with the average yield of catch on the different days

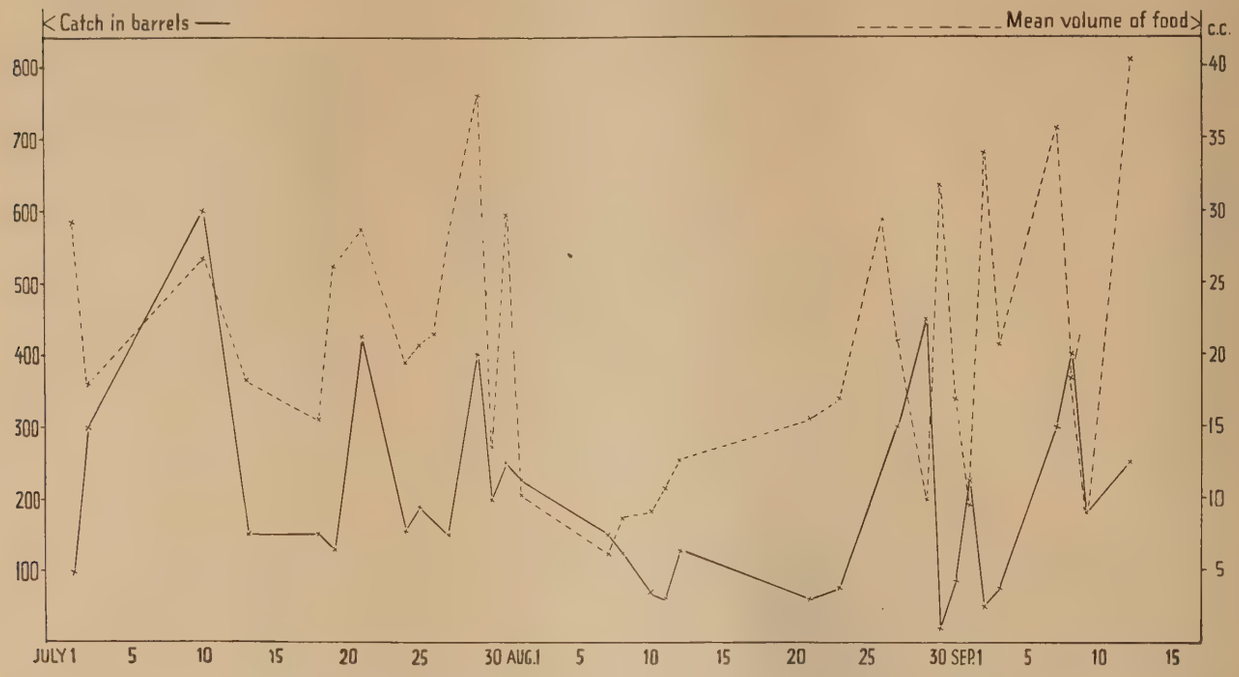

Fig. 5. Average catches of herring (in purse seine) and average volumes of food in the stomachs of purse seine herring, calculated per day throughout the herring season at Northern Iceland in 1930.

throughout the herring season. In the graphic representation given above (Fig. 5) are marked down the mean catches together with the average volumes of the stomach content of the herring.

In the main there seems to be a good correspondence between the two graphs, the heaviest catches occurring on fairly the same days as the great stomach content; on days when the stomach content is small the catches are generally comparatively light. At the beginning of the season there is a good correspondence between the course of the graphs, and in the first half of August when the herring stomachs contained remarkably small amounts of food, the yield of the purse seine fishing was very small, too. At the close of the season there are very great fluctuations both in food amount and in catch yield, but here it is impossible to demonstrate any correspondence for the individual days.

Also from the year 1931 we have information as to the catches per day of purse seine herring, but the fluctuations in the quantity of food are comparatively small; and although there is also here a certain degree of correspondence between yield and food amount, it is not so marked as in 1930.

In this connexion it should be mentioned that for the western part of the North Sea Savage (1931, p. 47) has demonstrated a certain correspondence between the food amount in herring stomachs and the size of the catches: in 1926 there were 3 times as many organisms in the herring stomachs as in 1922—23, and the quantity of herring landed in 1926 was nearly twice as large as that of 1922—23.

V. Nature and Composition of the Food of the Icelandic Herring.

In this section we are going to make a closer mention of the occurrence of various organisms in the food of the herring and their relative importance as food matter. The method used is as follows: at first we examine the relative quantity of herring in which the different organisms are met with as a feeding matter, and then we try to determine their importance for the herring. On account of the difference found both in quantity and nature of food of respectively purse seine herring and drift net herring we shall still proceed in a way so as to keep apart the herring caught in the two gears.

1. Relative Quantity of Herring feeding on the different Organisms.

It would be rather impracticable to state the nature of the food of each sample of herring examined, and so we shall collect the material into groups each of which comprises the material collected within a period of 10 days. On the basis of this classification Tables 4 and 5 give the relative quantity of respectively purse seine herring and drift net herring in which the principal organisms were found as food matter in the three years 1927, 1930, and 1931.

Table 4. Percentage of purse seine herring feeding on some of the most important groups of organisms.

	Copepods			Euphausids			Amphipods			Crab larvae			Pteropods		
	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931
29. VI—8. VII	..	100	100	..	30	100	..	22	57	..	0	7	..	0	0
9. VII—18. VII	100	100	100	100	43	100	0	41	11	4	0	35	0	0	0
19. VII—28. VII	100	100	100	100	76	100	14	18	19	0	50	42	0	1	4
29. VII—7. VIII	100	100	100	81	48	84	1	1	5	1	27	0	21	0	2
8. VIII—17. VIII	100	100	100	62	80	17	1	10	1	6	4	1	44	0	0
18. VIII—27. VIII	100	100	100	78	78	8	0	9	4	0	0	0	27	0	8
28. VIII—6. IX	100	100	100	75	81	28	0	2	1	0	0	0	29	0	0
7. IX—16. IX	..	100	100	..	90	61	..	2	7	..	0	0	..	0	0
17. IX—26. IX	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27. IX—6. X	100	..	..	10	..	..	0	..	..	0	..	..	20	..	..

Table 5. Percentage of drift net herring feeding on some of the most important groups of organisms.

	Copepods			Euphausids			Amphipods			Crab larvae			Pteropods		
	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931
19. VI—28. VI	..	99	0	..	53	100	..	15	62	..	5	0	..	0	0
29. VI—8. VII	..	91	94	..	58	59	..	8	39	..	0	3	..	0	0
9. VII—18. VII	..	100	82	..	70	65	..	50	13	..	40	11	..	0	0
19. VII—28. VII	..	98	69	..	74	74	..	45	13	..	1	4	..	0	0
29. VII—7. VIII	14	93	68	80	82	81	31	15	8	0	1	0	0	0	1
8. VIII—17. VIII	..	95	98	..	95	88	..	4	8	..	0	0	..	0	2
18. VIII—27. VIII	88	50	98	75	57	77	11	7	4	0	0	0	53	0	10
28. VIII—6. IX	77	..	60	47	..	70	0	..	10	0	..	0	45	..	20
7. IX—16. IX	88	..	42	76	..	50	24	..	17	0	..	0	60	..	0

In the tables are only given the five principal groups of food organisms, viz. copepods, euphausids, amphipods, crab larvae, and pteropods, all other organisms generally being of very slight importance to the Icelandic herring as a food matter. It will be seen that copepods are found in the food of a very great number of herring. Indeed copepods have been demonstrated in the stomach contents of all the purse seine herring examined. In the stomach contents of drift net herring copepods are less frequent, but this is partially due to some of the drift net herring examined having no stomach contents at all. Euphausids, too, occur very frequently in the food; they have been demonstrated within all the 10 days' periods in the food of a greater or smaller number of the herrings examined. But both amphipods, crab larvae, and pteropods did not occur as food within several of the 10 days' periods, and only in rare cases they were found as food in more than half the herrings examined. In the case of the two latter groups there is a marked difference in their occurrence at different times of the fishing season, a fact that will be more closely dealt with in the next section in the treatment of the importance of the various groups as food matter of the herring.

When we combine the results for the five food organisms by calculating the percentage from the total number of herring for the years 1927, 1930, and 1931, respectively, we get the following relative frequencies.

Table 6. Percentages of purse seine herring and drift net herring containing the five principal groups of food organisms, based on the total material of herring from the years 1927, 1930, and 1931, respectively.

	Copepods			Euphausids			Amphipods			Crab larvae			Pteropods		
	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931	1927	1930	1931
Purse seine herring....	100	100	100	79	70	71	2	11	10	2	13	17	26	1	2
Drift net herring.....	78	94	81	72	73	75	13	20	12	0	3	2	47	0	3

In order to convey an impression of the more or less frequent occurrence of the different organisms in the herring food we finally give the below survey of the relative quantity of herring — respectively purse seine herring and drift net herring — in the stomach contents of which the more important food organisms were met with. The calculations were made on the basis of the total number of herring from the said three years. In the former group is put down the crustaceous food, in the latter the non-crustaceous food. It is seen that crustaceous food is found in by far the greater number of herrings and that especially copepods and euphausids are of importance as food matter. Thus copepods were found in 100 and 84.5 per cent. of

	Purse seine herring	Drift net herring		Purse seine herring	Drift net herring
Copepods	100.0 %	84.5 %	Pteropods	10.0 %	12.6 %
Euphausids	73.5 -	73.8 -	Gastropods	2.6 -	0.4 -
Amphipods	7.6 -	14.9 -	Polychaets.....	— -	0.3 -
Crab larvae.....	10.3 -	2.0 -	Chaetognaths	0.4 -	0.3 -
Other decapods.....	— -	0.8 -	Fish	— -	1.3 -
Cirripede larvae	2.8 -	2.2 -	Fish eggs	2.4 -	1.1 -
Cladocerans	— -	0.6 -			

respectively purse seine herring and drift net herring, and the corresponding figures for euphausids were 73.5 and 73.8 per cent. Amphipods and crab larvae were demonstrated to occur as food in respectively 7.6 and 10.3 per cent. of the purse seine herring and in 14.9 and 2.0 per cent. of the drift net herring, while other crustaceans were found in less than 3 per cent. of the herring examined. Of non-crustaceous food pteropods were pointed out as food in 10.0 per cent. of the purse seine herring and in 12.6 per cent. of the drift net

herring while all other non-crustaceous organisms were only met with as food in quite a negligible number of both purse seine herring and drift net herring.

2. Importance of the various Organisms as Food Matter of the Herring.

It has already been mentioned above that in the determination of the occurrence of the various organisms in the stomach contents of the herring were applied the usual symbols of frequency cc, c, +, r, and rr. These statements of the occurrence of the organisms of course being based exclusively on a subjective esteem, it is impossible even approximately to give their exact numerical value. As, however, it is difficult to compare the more or less frequent occurrence of the different organisms or to parallel the results of the different stomach analyses on the basis of these determinations of frequency, we have fixed various figures corresponding to the respective indications of frequency. It should, however, still be kept in mind that, when we treat the material in this way, the figures obtained do not express in an absolute way the numerical occurrence of the different organisms; they will only convey a rough impression of the relative frequency of the organisms in the stomach contents of the herring.

In the calculations we used the following arbitrary figures. The frequency cc was called 100 and rr was called 1. To the intermediate indications of frequency, c, +, and r were given the values of 50, 25, and 5, respectively. Thus when converted into figures the scale will look like this: cc = 100, c = 50, + = 25, r = 5, rr = 1.

By way of illustrating the mode of proceeding an example is given below (Table 7) showing analyses of the stomach contents of 22 herrings. In the first column of the schematic survey are given the symbols of frequency generally applied (cc—rr) and in the second one they have been converted into the figures mentioned

Table 7. Example of the frequency of the different organisms, converted into figures fixed, in the stomach contents of 22 herrings.

Symbols of Frequency	Frequency values (v)	Copepods		Euphausids		Crab larvae	
		No. of herring (n)	v × n	No. of herring (n)	v × n	No. of herring (n)	v × n
cc.....	100	20	2000	3	300	..	..
c.....	50	2	100	5	250	..	..
+.....	25	..	..	10	250	1	25
r.....	5	..	..	3	15	6	30
rr.....	1	..	..	1	1	8	8
0.....	0	..	..	..	..	7	..
	Total...	22	2100	22	816	22	63
Mean values of frequency	$\frac{\text{Total v} \times \text{n}}{\text{n}}$	2100 : 22 = 95.4		816 : 22 = 37.0		63 : 22 = 2.8	

above which are called frequency values (v). In the sample given were found the following three groups of organisms in the stomach contents of the herring: copepods, euphausids, and crab larvae. For each of these is stated the number of herrings (n), in which the different organisms were found as food in quantities corresponding to the respective degrees of frequency. The numbers of herring (n) is then multiplied by the respective frequency values (v). By adding up the amounts produced in the column v × n we get a total which is divided by the total number of herring examined — in this case 22 individuals — and in this way we get an average expressive of the occurrence of the respective organisms in the herring food (mean value of frequency), the value 100, as already mentioned, representing the maximum frequency.

It appears from the above schematic survey that the following mean values of frequency of the groups of organisms were found in the stomach contents of the herrings examined: copepods 95.4, euphausids 37.0, and crab larvae 2.8. In other words: copepods were extremely numerous, coming very near to the maximum frequency cc (100); euphausids were also frequent, although to a less degree, viz. between + (25) and c (50). Crab larvae were scantily represented, viz. between rr (1) and r (5). The frequency values used being arbitrarily chosen the more infrequent occurrences (r and rr) are probably overvalued, and so their real values are no doubt comparatively lower than stated.

In the below treatment of the occurrence of the different organisms in the stomach contents of the herring the results of the stomach analyses in question have been worked in the way stated above, and although the calculated figures for the average frequency will by no means express the exact quantity of the organisms, a comparison of the results based on the said calculations will no doubt roughly convey an impression of the relative significance of the different organisms as herring food. In order not to complicate the account the analyses of the stomach contents were summarized in such a way that all stomach analyses of herring caught within a period of 10 days were considered one sample.

Copepoda. Of all the organisms serving as herring food along the coasts of Northern Iceland the copepods are by far the principal ones. This holds good in most cases, but at certain times herrings may be found with very few or no copepods in their stomachs. If in such cases there are any stomach contents at all,

Table 8. Number of herring examined together with mean values of frequency for the occurrence of copepods in the stomach contents of purse seine herring and drift net herring in 10 days' periods from the years 1927, 1930, and 1931.

	Purse seine herring						Drift net herring					
	1927		1930		1931		1927		1930		1931	
	No. of herring	Mean values of frequency	No. of herring	Mean values of frequency	No. of herring	Mean values of frequency	No. of herring	Mean values of frequency	No. of herring	Mean values of frequency	No. of herring	Mean values of frequency
19. VI—28. VI.....	..	..	..	..	..	..	..	..	92	95.4	8	0
29. VI—8. VII.....	..	..	26	100.0	14	100.0	..	..	12	85.4	64	86.8
9. VII—18. VII....	23	80.4	58	100.0	71	97.9	..	..	10	100.0	83	62.9
19. VII—28. VII...	91	82.1	133	100.0	159	95.3	..	..	66	89.1	55	19.3
29. VII—7. VIII...	218	96.4	137	100.0	120	98.7	35	2.9	194	74.0	167	7.9
8. VIII—17. VIII ..	210	100.0	119	100.0	70	100.0	..	..	22	83.2	52	58.6
18. VIII—27. VIII .	122	93.9	63	100.0	24	100.0	216	61.3	14	16.9	149	95.8
28. VIII—6. IX....	52	100.0	133	99.4	75	100.0	40	32.9	..	..	10	8.7
7. IX—16. IX	..	..	55	59.5	13	100.0	25	61.4	..	..	12	0.7
17. IX—26. IX	..	..	..	..	..	..	..	..	..	..	..	..
27. IX—6. X	20	100.0	..	..	..	..	..	..	..	..	..	..

euphausids generally make up the bulk of it. It has already been mentioned that copepods occur as food in all the purse seine herring examined, and from above table, in which the mean values of frequency have been calculated from the scale mentioned above, it appears that the frequency value for copepods in the stomachs of purse seine herring only in one of the 10 days' periods is below 80, and that in most cases it lies between 90 and 100, i. e. very near to the maximum value. In this table is further given the number of herring examined.

However, if we look at the mean values of frequency for copepods in the stomach contents of drift net herring, which are also given in the above table, we note a far less frequent occurrence than was the case

with the purse seine herring. A calculation of the mean figure for the frequency values of all the 10 days' periods of each year — for purse seine herring and drift net herring, respectively — will give the following numbers:

Purse seine herring	1927	93.2	Drift net herring	1927	39.6
—	1930	96.8	—	1930	77.7
—	1931	99.0	—	1931	37.9

In the said three years the variation of the frequency value is very small as far as the purse seine herring is concerned, but in the case of the drift net herring the value fluctuates very much. The mean value of frequency for copepods in drift net herring was comparatively small in the years 1927 and 1931 and much higher in 1930, but even then considerably lower than the values for purse seine herring in the same three years. Table 8 further shows that the frequency values for the individual 10 days' periods were rather unsteady as far as the drift net herring are concerned, but the fluctuations of the individual years do not seem to be very regular.

From the spring we have some investigations of the stomach contents of a small number of drift net herring from the water off the south-eastern coast of Iceland. They are all from the month of May, and the bulk of them date from the year 1927 when the stomach contents of 41 herrings were analysed. A characteristic of these samples is the scanty occurrence of copepods, whereas adult euphausids constitute the bulk of the stomach contents. In 12 individuals (29 per cent.) there were no copepods at all, and in all the other herrings copepods were very sparse. The mean value of frequency for the occurrence of copepods in the stomach contents of all 41 herrings only amounts to 1.9.

From September (7th—16th), 1929 we further have some analyses of the stomach contents of herring caught in bar-nets in the Eyjafjord. The material, which consists of 7 samples, comprises 77 herrings in all. The average volume of food in these herring is highly varying, viz. from 2.9 to 24.0 c.c. in the individual samples, and copepods make out a material part of the stomach contents, the rest of which consists of euphausids. The mean value of frequency in the stomach contents of these herring is for copepods 67.4 and for euphausids 42.8.

By far the most important copepod in the food of the herring at Northern Iceland is *Calanus finmarchicus* (Gunnerus), and on the whole this copepod is no doubt the principal food animal of the herring in Icelandic waters. It is well-known that in summer it may occur in such quantities in the upper layers of the waters north of Iceland, that the water gets a reddish tinge. Of all copepods found in the stomach contents of the herring, this species is so preponderant, that no doubt it constitutes at least 95 per cent. of the copepods. In a few cases samples of herring were found, in the stomach contents of which another species predominated, viz. *Temora longicornis* (Müller). This was the case with some samples from August 1931, both of purse seine herring and drift net herring, caught in the waters off Skagafjord and Siglufjord. However, this is an exceptional case, *Calanus finmarchicus* generally preponderating in number as compared with other copepods. Besides the two said species especially the following ones were found in the stomach contents of the herring: *Calanus hyperboreus* Kröyer, *Metridia longa* (Lubbock), *Pseudocalanus elongatus* Boeck, *Microcalanus pygmæus* G. O. Sars, *Acartia longiremis* (Lilljeborg), and *Oithona similis* Claus, but all of them were met with in comparatively small numbers, and as herring food they play quite an inferior part.

A great part of the copepods were at different stages of development, and in the stomach contents of the herring were further established a small number of copepod nauplii which could not possibly be determined as to species.

Euphausidae. After the copepods the euphausids are no doubt the most important of the food organisms of the herring at Northern Iceland. In the below table are given the mean values of frequency for 10 days' periods of the three years from which we have a large number of stomach analyses.

Table 9. Mean values of frequency for the occurrence of euphausids in the stomach contents of purse seine herring and drift net herring in 10 days' periods from the years 1927, 1930 and 1931.

Purse seine herring	19. VI—28. VI	29. VI—8. VII	9. VII—18. VII	19. VII—28. VII	29. VII—7. VIII	8. VIII—17. VIII	18. VIII—27. VIII	28. VIII—6. IX	7. IX—16. IX	17. IX—26. IX	27. IX—6. X
1927	..	..	97.8	42.8	27.2	11.9	20.2	4.0	..	..	0.1
1930	..	1.2	7.3	15.0	7.1	17.3	14.3	38.2	82.4	..	..
1931	..	6.4	54.7	77.2	13.4	0.2	0.1	0.4	0.6	..	..
Drift net herring											
1927	..	..	..	..	49.6	..	17.5	3.2	22.8	..	..
1930	10.2	19.1	1.5	9.3	15.3	20.1	20.8	..	..	..	..
1931	68.7	4.9	8.8	21.5	39.5	24.8	6.5	6.7	0.8	..	..

A look at the frequency values of the different 10 days' periods within the individual years will show that they vary highly, but furthermore there seems to be a considerable difference between the three years.

In the case of the purse seine herring there is a fairly uniform decrease of the values from the month of July to August and September of the years 1927 and 1931, whereas in 1930 there is a rise from July to the middle of September. A more accurate comparison of the stomach analyses from the three years will show that practically no adult euphausids were found in the herring food from 1927 and 1931 whereas in 1930 rather considerable quantities were demonstrated to occur in the stomach contents of herring from the close of the fishing season, which is the reason for the high frequency value of the euphausids at this time. Further it should be mentioned that the material from September 1930 originates from Skjalfandi Bay and the waters east of this locality, while from September 1927 and 1931 we have only material from waters situated more westerly, so that the diversified occurrence of euphausids in the herring is possibly to some degree due to the different localities. If we calculate the mean values for the 10 days' periods of the three years we get:

Purse seine herring 1927: 29.1, 1930: 22.8, 1931: 19.1
Drift net herring 1927: 23.3, 1930: 13.8, 1931: 20.2

As the corresponding values for the occurrence of copepods in the food ranges between 93.2 and 99.0 for purse seine herring and between 37.9 and 77.7 for drift net herring, it is seen that the importance of the euphausids as herring food is much inferior to that of the copepods.

According to the table we cannot demonstrate any regular variations in the frequency values for the occurrence of euphausids in the stomach contents of drift net herring, but on the whole far more adult euphausids are found in drift net herring than in purse seine herring. This will appear from the below survey of the

Table 10. Survey of the relative amount of purse seine herring and drift net herring from the years 1927, 1930 and 1931, the stomachs of which were found to contain adult euphausids.

	Purse seine herring			Drift net herring		
	1927	1930	1931	1927	1930	1931
No. of herring	736	724	546	316	410	613
No. of herring with adult euphausids	15	68	8	67	172	157
Percentage of herring with adult euphausids	2.0	9.4	1.5	21.2	42.0	25.6

relative amount of respectively purse seine herring and drift net herring with adult euphausids in their stomachs. In the material given were only included herring with detailed dates on the nature of the stomach contents.

It appears from this that adult euphausids were found as food in 1.5—9.4 per cent. of the purse seine herring from the three years, but they were met with as food in no less than 21.2—42.0 per cent. of the drift net herring examined.

For the purpose of inquiring into the quantities in which the young stages of euphausids occur in the herring food we use the material from the summer of 1931. A survey is given below of the mean values of frequency for the occurrence of young euphausids in the stomach contents of purse seine herring and drift net herring from the different 10 days' periods throughout the fishing season of this year.

	19. VI—28. VI	29. VI—8. VII	9. VII—18. VII	19. VII—28. VII	29. VII—7. VIII	8. VIII—17. VIII	18. VIII—27. VIII	28. VIII—6. IX	7. IX—16. IX
Purse seine herring.....	—	6.4	54.7	77.2	13.4	0.2	0.1	0.4	0.6
Drift net herring.....	0	0.7	7.4	20.1	39.1	12.5	5.2	4.1	0.1

Especially in July and the beginning of August the young stages of euphausids play a part in the diet of the herring, but both before and after this time they are of slight importance. There is a fairly good correspondence between the values of purse seine herring and of drift net herring although in the former the frequency reaches considerably higher values than in the latter. Moreover, it is worth noting that there is a difference in the time of the maximum value for purse seine herring and for drift net herring. This is possibly due to the fact that at the beginning of the season the young euphausids are found in the upper water layers where they are principally taken by the herring which are caught in the purse seine, but gradually they go deeper into the water where they are preyed on to a higher degree by the herring that are taken in drift nets.

Thus we see that principally the young stages of euphausids are of importance as a food matter of the Icelandic herring in summer. Of adult individuals the following species were pointed out: *Meganyctiphanes norvegica* M. Sars, *Rhoda Raschii* M. Sars, *Rhoda inermis* Kröyer, and *Thysanoëssa longicaudata* (Kröyer)[1].

Of material from other seasons of the year we have, as already mentioned, an investigation of 41 herrings caught in drift net off the south-eastern coast of Iceland in May, 1927. Euphausids, more especially adult specimens, were by far the most important food organisms of these herring. The mean value of frequency was 50.6 for euphausids, but only 1.9 for copepods. Some few stomach analyses of herring from the same area in the spring of the years 1906, 1925, and 1930 all go to show that adult euphausids are by far the most important food organisms. The most frequent species were *Meganyctiphanes norvegica* and *Rhoda inermis*.

Dr. Bjarni Sæmundsson has most kindly given me the results of an examination of 15 herrings caught in drift net off the mouth of Skagafjord as early as June, 7th (1929). Of these 15 herrings two were without stomach contents; the stomachs of 4 specimens were half full of *Rhoda* sp. while 9 had gorged on the same euphausid. Further Dr. Sæmundsson has examined the stomach contents of a few herring found in the stomachs of cod-fish which were caught on the Hali, a shoal off the north-western part of Iceland. These herring, which were examined in August, 1926, had nothing but euphausids in their stomachs, partly *Rhoda inermis*, partly *Meganyctiphanes norvegica*.

Finally we have from the Eyjafjord a sample consisting of 77 herrings which were taken in bar-nets from Sep. 7th to 16th, 1929. These herring had young stages as well as adult specimens of euphausids in their stomachs, and the frequency value of euphausids averaged 42.8.

Mysidae. Only in rare cases mysids were met with in the stomach contents of the herrings examined. Apart from a few indeterminable specimens found scatteringly in the material a greater number of mysids has only been found in the stomach contents of one sample of herring caught in purse seine on July 30th,

[1] Dates on the distribution of these species are given by Ove Paulsen (1909).

1927, in the inner part of the Skagafjord. The sample consisted of 20 herrings, and mysids were found in 4 of them — as far as could be seen they were exclusively *Michtheimysis mixta* Lilljeborg. In one of the herrings only individual specimens were found, but each of the three others had 25—30 mysids in their stomachs.

Amphipoda. As food of the Icelandic herring amphipods are of quite inferior importance. As may be seen from Tables 4 and 5 (p. 15) amphipods occurred as food in a comparatively large number of herring, especially drift net herring, but they were always very few in number as will appear from the below table giving the mean values of frequency.

Table 11. Mean values of frequency for the occurrence of amphipods in the stomach contents of purse seine herring and drift net herring in 10 days' periods from the years 1927, 1930, and 1931.

Purse seine herring	19. VI— 28. VI	29. VI— 8. VII	9. VII— 18. VII	19. VII— 28. VII	29. VII— 7. VIII	8. VIII— 17. VIII	18. VIII— 27. VIII	28. VIII— 6. IX	7. IX— 16. IX	17. IX— 26. IX	27. IX— 6. X
1927	..	..	0	0.1	0.01	0.01	0	0	..	..	0
1930	..	1.5	1.1	0.2	0.01	0.1	0.1	0.02	0.02	..	..
1931	..	0.6	0.1	0.2	0.05	0.01	0.04	0.01	0.08	..	..
Drift net herring											
1927	..	..	..	..	1.0	..	0.2	0	4.3	..	..
1930	0.2	0.1	0.9	0.7	0.3	0.1	0.1	..	..	..	..
1931	4.6	0.6	0.2	0.1	0.2	0.1	0.04	0.1	0.2	..	..

The amphipods found in the stomach contents were all Hyperiids, in most cases in their young stages. It was often impossible to determine them as to species, but by far the greater part of them seem to belong to the species *Themisto abyssorum* Boeck.

Decapoda. Adult specimens of decapods were never met with in the food of the herring. Young stages of shrimps were found a few times but in extremely small numbers. Suffice is to mention a find of 8 *Pandalus* sp. (5—7 cm. long) in a herring from the eastern side of Huna Bay (Aug. 11th, 1927).

Larval stages of crabs, however, may sometimes occur abundantly in the stomach contents of the herring. The mean value of frequency in purse seine herring and drift net herring is seen by the following table.

Table 12. Mean values of frequency for the occurrence of crab larvae in the stomach contents of purse seine herring and drift net herring in 10 days' periods from the years 1927, 1930, and 1931.

Purse seine herring	19. VI— 28. VI	29. VI— 8. VII	9. VII— 18. VII	19. VII— 28. VII	29. VII— 7. VIII	8. VIII— 17. VIII	18. VIII— 27. VIII	28. VIII— 6. IX	7. IX— 16. IX	17. IX— 26. IX	27. IX— 6. X
1927	..	..	0.04	0	0.01	0.1	0	0	..	..	0
1930	..	0	0	4.6	2.5	0.04	0	0	0	..	..
1931	..	0.07	4.6	0.7	0	0.01	0	0	0	..	..
Drift net herring											
1927	..	..	..	..	0	..	0	0	0	..	..
1930	0.1	0	5.2	0.02	0.1	0	0	..	..	..	..
1931	0	0.8	1.4	0.04	0	0	0	0	0	..	..

The highest frequency value found for one 10 days' period is 5.2, but we further notice that crab larvae have only been pointed out in the food of herring which were caught during the first part of the herring season,

i. e. from the middle of June to the middle of August. This period coincides with the time when enormous quantities of crab larvae are sometimes met with in the waters north of Iceland. This is especially the case in July and the beginning of August when the crab larvae are sometimes seen to form large, dark-coloured streaks or patches in the surface of the water. From the "DANA" we have taken out a bucket-ful of surface-water in such places, and so many crab larvae were found in the water that after it had been left quiet for some time they formed a layer of about $^1/_2$ cm. on the bottom of the bucket. In the summer of 1926, e. g., crab larvae occurred in enormous quantities in July from Huna Bay to Axarfjord. A small sample taken off Skagafjord on July 10th, 1926 I sent for determination to Dr. M. V. Lebour, Plymouth, who most kindly informed me that the sample seemed to consist chiefly of megalopae and a good many second (last) zoëas of *Hyas coarctatus* Leach. As a matter of fact large numbers of crab larvae were found in the stomach contents of herring caught in such places. From July 18th—20th, 1926 we have got the stomach analyses of 4 samples consisting of 182 herrings. Crab larvae were found as food in 38, 52, 70, and 72 per cent. of the 4 samples, and the calculated frequency values for crab larvae averaged 14.8, 18.1, 27.5, and 43.6, respectively. The average figure for the mean values of frequency being 26.0, we see that at the said time crab larvae formed an important item in the herring food.

Cladocera. Cladocerans occurred so scantily in the herring food, that their importance as food matter is nil. Some few cladocerans were sometimes found among the many copepods, but they were always extremely few in number. Besides the genus *Podon* specimens of *Evadne Nordmanni* Loven were established.

Cirripedia. Cirripede larvae were often found in the herring food but only during the first part of the season until about the middle of August. However, they were always so few in number, that the mean value of frequency did not reach 1 in any of the 10 days' periods of the years 1927, 1930, and 1931; this holds good of both purse seine and drift net herring. Both nauplii and cypris stages of cirripedes were met with in the stomach contents of the herring, the former being by far the most numerous.

Ostracoda. In very few cases individual ostracods occurred in the stomach contents, but they were always in such a state that a determination was rendered impossible.

Polychaeta. These organisms are of quite inferior value, only very few pelagic polychaetes having been established in the herring food; they were always in an advanced stage of decomposition.

Pteropoda. The pteropods rate among the chief organisms in the non-crustaceous food of the herring; but their comparative importance as herring food is generally small, which appears from the below table.

Table 13. Mean values of frequency for the occurrence of pteropods in the stomach contents of purse seine herring and drift net herring in 10 days' periods from the years 1927, 1930, and 1931.

Purse seine herring	19. VI—28. VI	29. VI—8. VII	9. VII—18. VII—	19. VII—28. VII	29. VII—7. VIII	8. VIII—17. VIII	18. VIII—27. VIII	28. VIII—6. IX	7. IX—16. IX	17. IX—26. IX	27. IX—6. X
1927	..	..	0	0	1.0	0.9	0.3	0.4	..	..	0.2
1930	..	0	0	0.01	0	0	0	0	0	..	..
1931	..	0	0	0.04	0.02	0	0.08	0	0	..	..
Drift net herring											
1927	..	..	..	..	0	..	9.6	18.5	4.8	..	..
1930	0	0	0	0	0	0	0	..	..	..	..
1931	0	0	0	0	0.01	0.02	0.3	0.2	0	..	..

As food of the purse seine herring the pteropods are insignificant, and only in one year (1927) they occurred numerously in the stomach contents of drift net herring. As will be seen from the table they have in one 10 days' period attained a mean value of frequency of 18.5, and on the whole they are met with abundantly in the herring food from the middle of August till the middle of September of the said year.

That pteropods may sometimes be found in large quantities in the herring food is further proved by some stomach analyses of 2 samples of drift net herring from July 27th and 29th, 1926. The 2 samples, which comprised 47 and 50 herrings, showed that pteropods occurred as food in 63.8 and 98.0 per cent., respectively, of the herrings examined. The frequency value for pteropods in the two samples of herring averaged 15.4 and 65.7, respectively. The samples prove that pteropods are sometimes very numerous in the herring food already in July, though their numerical strength in the herring food seems to be greater in August and September.

The pteropods met with in the stomach contents of the herring[1] belong to the species *Limacina retroversa* Fleming and *Limacina helicina* (Phipps), the former being apparently far more numerous than the latter. Strange to say no specimens of *Clione limacina* Phipps were ever found in the herring food although this species may sometimes occur abundantly in the plankton along the coasts of the northern country, but this is possibly due to this species being more difficult to identify in the stomach contents than the shell-bearing pteropods.

Gastropoda. Larval gastropods were found now and then as part of the stomach contents of the herring but never in numbers worth mentioning. Most frequently they were met with in the food of purse seine herring, but in none of the 10 days' periods of 1927, 1930, and 1931 did their mean value of frequency reach 1. The months of August and September were almost the only time when gastropod larvae were established in the herring food.

Chaetognatha. Of chaetognaths *Sagitta* were sometimes found to be herring food. Apart from some scattering samples, of which some few herrings contained individual specimens, *Sagitta* in large numbers were met with in only one sample of purse seine herring caught in the Eyjafjord on Sept. 11th, 1931. The sample consisted of 13 herrings, in 6 of which *Sagitta* appeared as food. In these 6 individuals *Sagitta* got the following indications of frequency: 2 ind. c, 2 ind. +, and 2 ind. rr. Consequently the mean value of frequency for *Sagitta* in the stomach contents of the said herring sample was 11.7.

Fishes. In the large material of herring caught in purse seine and drift net in the years 1927, 1930, and 1931 few fishes were found as food in a comparatively small number of herring. In all the 10 days' periods of the three years the highest frequency value was 0.3, but still there were some few herring samples in which rather a considerable number of fishes constituted part of the stomach contents.

In August 1927, e. g., young specimens of capelin (*Mallotus villosus* O. F. M.) were established in the stomach contents of 3 different herring samples, which were all caught in the eastern part of the water along the northern country, viz. from Axarfjord to Thistilfjord. In the water off the latter fjord *Mallotus* were found in the largest number and as food in not less than 14 out of 19 herrings examined.

Although *Mallotus* may consequently be of some importance as herring food, there is hardly any doubt that young stages of sand eels (*Ammodytes*) sometimes play a far greater part as food matter. During the investigations made from the research vessel "DANA" along the northern country in the summer of 1926 this was established very convincingly. During a stay of two days (July, 12th—13th) in the Reykjarfjord, which indents the western side of Huna Bay, several herring shoals were observed in the surface of the water. It soon turned out that *Ammodytes* were driven to the surface and snatched by the herring. *Ammodytes* occurred in such quantities that from the dingey you could take them out of the water with your hands. In fact, stomach analyses proved that *Ammodytes* constituted the bulk of the herring in this locality. Of 100 her-

[1] On the distribution of pteropods around Iceland, see Ove Paulsen, 1909.

rings examined 96 had *Ammodytes* in their stomachs, and several of them had gorged on this fish. The amount of *Ammodytes* varied highly in the individual herring stomachs, but the average figure per herring was 52. The greatest number found in one stomach was 220, which, after settlement, corresponds to a volume of abt. 35 cc. Besides *Ammodytes* part of the herring (52 per cent.) contained varying quantities of copepods, and a smaller number (12 per cent.) had crab larvae in their stomachs. The length of the *Ammodytes* ranged between 4 and 6 cm., and stomach analyses proved them to contain some copepods, a few *Limacina*, and particularly many larval cirripedes. When somewhat later, on July, 26th of the same year, the "DANA" returned to this fjord, the herring as well as the large quantities of *Ammodytes* had disappeared.

Other stomach analyses from the same year show that in certain places fishes constituted a material part of the stomach contents of the herring. Of a sample of 22 herrings taken in bar-nets in the Skjalfandi Bay on July, 17th, 63 per cent. had fishes in their stomachs. On an average there were 4 pieces per herring stomach, and with the exception of 3 post-larval herrings (*Clupea harengus*) with a length of 5—6 cm. they were exclusively young stages of *Ammodytes*. Further may be mentioned a sample of 38 herrings caught in drift net on July 18th, 1926. 15 of them (39 per cent.) had fishes in their stomachs. In the stomach analyses was found a total of 70 post-larval fish, but only 18 of them were *Ammodytes* (length 3—6 cm.) while the others were larval gadoids (length 1.5—3.0 cm.), *Gadus callarias* constituting the majority. Finally 20 *Ammodytes* of 5—5.5 cm. in length were found in the stomach contents of one herring caught on July 31st, 1931, in Hjedinsfjord at the mouth of Eyjafjord.

To judge from these investigations especially *Ammodytes* may be of some importance in the food of the herring, and the dates in hand seem to indicate that this is more particularly the case in the fjords.

Pelagic fish ova were often found in the herring stomachs examined but always in very small numbers, so that their importance as food matter of the herring along the coasts of the northern country is extremely small. Only at the beginning of the season till the middle of August fish eggs were established in the food. It is a well-known fact that the great majority of the fish occurring at Iceland, as e. g. Cod, Coalfish, Haddock, Whiting, Ling, and Plaice, will in most cases spawn off the southern and western coasts of the country (see i. a. Johs. Schmidt, 1904 and 1909, and Å. Vedel Tåning, 1929), and so we naturally find comparatively few fish eggs in the stomach contents of the herring which are caught along the coasts of the northern country.

VI. Summary.

The present investigation, which is exclusively based on analyses of stomach contents, is in all essentials confined to the food of the herring that are found in the waters along the coasts of Northern Iceland in summer. The investigation includes a total of about 4900 stomach analyses of adult herring, 3500 of which were caught during the three years 1927, 1930, and 1931 when more continuous collections were made. By far the greater part of the stomachs examined was taken from herring caught in purse seine and drift net. A survey of the material from the said three years is given on p. 4.

There has turned out to be considerable differences between purse seine herring and drift net herring both with regard to quantity and to nature and composition of the food, and so a continuous distinction was made between the herring caught in the two different gears.

The food amount of purse seine herring was on the whole much larger in the summer of 1930 than in 1927 and especially in 1931 (Fig. 2), and the same holds good of the quantity of food in drift net herring from the three years (Fig. 3). If, however, we compare the food amounts of purse seine herring and drift net herring from the three years (Fig. 4), we see that in the months of July, August, and September the quantity of food is always much larger in purse seine herring than in drift net herring; but earlier in the fishing season, in the latter half of June and the beginning of July, the years 1930 and 1931 showed quite considerable food

amounts in the drift net herring as well. For the rest it is a characteristic feature of the drift net herring that quite a great part of them is often found to be empty of food, but this is never the case with the purse seine herring. The difference in food amount between purse seine herring and drift net herring is presumably due to the purse seine herring living in somewhat higher water layers than the drift net herring, the former thus inhabiting water layers with greater plankton contents.

For the summer of 1930 a certain correlation has been demonstrated between the catch yield of herring and the amount of food in their stomachs (Fig. 5), the heaviest catches coinciding fairly well with the days when the herring stomachs contained much food whereas the catches were comparatively light on days showing less stomach contents.

The most important food organisms of the Icelandic herring are copepods, euphausids, amphipods, crab larvae, and pteropods, the first two groups by far outweighing the others. If on the basis of the material collected in the years 1927, 1930, and 1931 we examine the relative quantity of respectively purse seine herring and drift net herring in which the five groups of organisms have been found as food, we get the following figures:

	Purse seine herring	Drift net herring
Copepods	100.0 per cent.	84.5 per cent.
Euphausids	73.5 —	73.8 —
Amphipods	7.6 —	14.9 —
Crab larvae	10.3 —	2.0 —
Pteropods	10.0 —	12.6 —

All other organisms contained in the stomach contents of the herring were found in less than 3 per cent. of the herrings examined.

In the investigation of the occurrence of the different organisms in the herring food were applied the usual symbols of frequency (cc, c, +, r, rr), and so, for comparison's sake, it has been necessary to establish different values corresponding to the respective indications of frequency. These arbitrary figures were fixed at cc = 100, c = 50, + = 25, r = 5, and rr = 1, the figure 100 thus being the maximum. Calculations were made on the basis of these values, as was illustrated through the example given on p. 17, and by this means we have managed roughly to express the relative frequency of the different organisms in the stomach contents of the herring. By further calculations of the mean value of the different organisms in a sample of herring we get a figure stating the mean value of frequency for the occurrence of the individual groups of organisms in the food of each herring sample.

In the below is given a summary of the importance of the different groups of organisms as food of the herring along the coasts of Northern Iceland in summer.

Copepoda. The copepods are by far the most important of all organisms serving as herring food but their proportionate occurrence in the stomach contents is much more abundant in purse seine herring than in drift net herring. The mean values of frequency for the occurrence of copepods in the stomach contents of purse seine herring and drift net herring in the years 1927, 1930, and 1931 are as follows:

Purse seine herring	1927	93.2	Drift net herring	1927	39.6
—	1930	96.8	—	1930	77.7
—	1931	99.0	—	1931	37.9

The variation of the frequency value in the three years was very small in the case of the purse seine herring and very near to the maximum value (100), but in the case of the drift net herring the variation was

very great in the three years. In 1930 the frequency value for copepods in the stomach contents of drift net herring was comparatively high (77.7) although much lower than the values for purse seine herring in the three years, when it ranged between 93.2 and 99.0.

It turned out in some examinations of the stomach contents of drift net herring caught in May off the south-eastern coast of Iceland that in this place and at the said time of the year the value of the copepods as food matter is next to nothing, their mean value of frequency only reaching 1.9. The rule seems to hold good that when the stomach contains few copepods, the herring is mainly living on euphausids.

Calanus finmarchicus is by far the most conspicuous copepod species in the herring food. It is certain to make at least 95 per cent. of all copepods, and so it is no doubt the most important food animal of the Icelandic herring. Further some other species of copepods were established in the stomach contents of the herring, but as food matter they were all of quite inferior importance.

Euphausidae. Next to the copepods euphausids, more especially their young stages, are undoubtedly the most remarkable food organisms of the herring. The mean values of frequency for euphausids in the stomach contents of herring during the three years of systematic researches, are as follows:

Purse seine herring	1927	29.1	Drift net herring	1927	23.3
—	1930	22.8	—	1930	13.8
—	1931	19.1	—	1931	20.2

A comparison with the corresponding figures for the copepods will show quite obviously that in the food of the herring the importance of the euphausids is on the whole much inferior to that of the copepods.

Adult specimens of euphausids were found as food in drift net herring far more numerously than in purse seine herring, viz. in 21.2—42.0 per cent. of the former, but only in 1.5—9.4 per cent. of the latter during the three years. However, young stages are generally much more frequent than the adult ones, of which the following species have been established: *Meganyctiphanes norvegica, Rhoda Raschii, Rhoda inermis,* and *Thysanoëssa longicaudata.*

Off the south-eastern coast of Iceland adult euphausids seem to be a food matter much sought after by the herring in spring. Thus, in a sample of drift net herring from May, 1927, the mean value of frequency for the occurrence of adult euphausids in the stomach contents amounts to not less than 50.6.

Amphipoda. Hyperiid amphipods are very often met with in the stomach contents of the herring, but nearly always in very small numbers, comparatively, so that their actual importance as food is next to nothing. The most common species in the herring food is *Themisto abyssorum.*

Decapoda. Of these crab larvae are the only ones that may be of any great importance as herring food though exclusively during the first part of the seasonal herring fishery, viz. from the middle of June to the middle of August. Most of the crab larvae are no doubt *Hyas coarctatus* at various stages of development. In July, 1926 enormous quantities of crab larvae occurred in the waters along the greater part of Northern Iceland, and stomach analyses of herring showed that these crab larvae were preyed upon extensively by the herring. The mean value of frequency for the occurrence of crab larvae in the stomach contents of a large number of herrings from these localities was 26.0.

Of crustaceans otherwise found to constitute part of the stomach contents, may be mentioned: mysids, cladocerans, cirripede larvae, and ostracods, but generally so few specimens were established, that their nutritive value is of practically no moment.

Pteropoda. In the non-crustaceous food of the herring the pteropods are the chief organisms, but generally they are few in number so that on the whole they are of slight importance as food matter. This is especially the case with the purse seine herring whereas in one year — August—September, 1927 — rather considerable amounts of pteropods occurred in the stomach contents of drift net herring, and in one sample of herring from the end of July, 1926 were found so many pteropods in the stomach contents of herring, that the frequency value averaged 65.7. On the basis of the investigations in hand, however, this high value in the case of the pteropods must be considered quite exceptional. The pteropods met with in the herring belong to the species *Limacina retroversa* and *Limacina helicina*, and a distinctive feature in their occurrence in the herring food is their great numerical strength in the months of August and September.

Fishes. Broadly speaking young specimens of fish are of no great nutritive value to the herring, only now and then large numbers of young sand eels (*Ammodytes*) have been found in the stomach contents. In the Reykjarfjord, e. g., stomach analyses on July 12th—13th, 1926 showed the presence of *Ammodytes* in plenty in the herring food. Out of 100 stomachs examined 96 contained *Ammodytes*, the mean number per herring being 52 specimens. Further postlarval stages and young specimens of *Mallotus villosus*, *Clupea harengus* and *Gadus callarias* were occasionally found to occur in the stomach contents of the herring.

Among the non-crustaceous food were finally observed pelagic polychaetes, larval gastropods, chaetognaths (*Sagitta*), and fish eggs, but all of these occurred so scantily as to be of quite inferior importance as herring food.

Tables of Stomach Analyses.

List of dates and positions for samples of herring the stomach contents of which have been examined, together with mean values of frequency for the occurrence of some of the most important groups of organisms in the stomach contents in 1927, 1930, and 1931.

A. Herring caught in purse seine.

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1927																
July 16	Haganesvik	20	17.3	100	22	..	2	..	..	..	0.1	..	..	..	..	..
— 17	—	23	10.6	80	98	..	0.1	..	..	0.1	..	..	..	..	..	..
— 20	Skagafjord	17	15.2	100	24	..	..	..	..	..	..	..	..	0.1	..	..
— 22	Skjalfandi Bay	21	8.8	37	95	0.1	..	..	..	..	..	..	..	..	0.1	..
— 25	—	15	8.6	100	9	..	..	..	..	..	..	..	..	..	..	..
— 27	Grimsey Flak	19	6.9	84	69	0.6	..	..	..	..	..	..	..	..	..	..
— -	Skagafjord	19	6.9	100	2	..	..	..	..	..	..	..	..	..	..	..
— 30	—	20	14.1	100	..	..	..	12	..	..	6	..	..	..	..	..
Aug. 2	Skjalfandi Bay	19	17.2	95	47	0.1	..	..	..	..	..	..	..	..	..	..
— -	Thistilfjord	19	19.8	79	100	..	..	..	..	..	..	..	..	..	3	..
— -	Skagafjord	20	4.3	100	1	..	0.1	..	..	..	0.5	..	..	..	..	..
— 3	Skjalfandi Bay	21	11.5	100	22	..	..	..	..	..	..	..	..	..	..	..
— -	—	20	28.4	100	0.7	0.1	..	..	..	..	..	..	..	..	..	..
— -	Eyjafjord	18	8.1	100	11	..	..	0.1	..	..	0.4	..	..	..	..	..
— 4	Thistilfjord	20	16.9	100	90	..	..	..	..	..	..	..	..	..	0.2	..
— -	—	20	5.5	85	29	..	..	..	..	..	1	..	..	0.1	..	..

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans.	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1927																
Aug. 6	Skagafjord	19	15.7	100	1	..	..	..	..	..	0.1	..	..	..	..	..
— -	Thistilfjord	22	12.7	100	3	..	..	..	..	..	2	..	..	0.1	..	..
— 9	Skagafjord	29	18.4	100	..	..	..	..	..	..	0.6	..	..	..	..	..
— 10	Thistilfjord	20	5.2	100	12	..	..	..	..	0.1	1	..	..	..	..	..
— 11	Huna Bay	20	11.7	100	0.3	..	..	0.2	..	..	1	..	..	..	..	..
— 13	Skagafjord	21	5.1	100	..	0.1	..	..	..	..	0.6	..	..	..	..	0.1
— 15	Axarfjord	27	14.2	100	28	0.1	..	..	..	..	..	..	..	..	..	..
— 16	Haganesvik	20	17.3	100	22	..	1	..	..	..	0.1	..	..	..	..	..
— 17	Axarfjord	18	12.9	100	28	..	..	..	..	..	0.2	..	..	..	..	..
— -	Skagafjord	20	10.4	100	1	..	..	0.1	..	..	0.2	..	..	..	..	..
— -	Grimsey Flak	15	8.9	100	32	..	..	..	..	..	2.0	..	..	..	..	..
— 18	Axarfjord	20	10.1	63	83	..	..	..	..	..	..	..	..	..	0.1	..
— -	Skjalfandi Bay	22	8.0	100	1	..	..	..	..	..	1	..	..	..	..	..
— -	Grimsey Flak	20	18.9	100	21	..	..	..	..	..	0.5	..	..	..	..	..
— 19	Off Siglufjord	10	22.2	100	0.1	..	..	..	..	..	..	..	..	..	..	..
— 20	- Haganesvik	10	8.1	100	1	..	..	..	..	..	1	..	..	..	..	..
— 23	Langanes Flak	20	26.0	100	14	..	..	..	..	..	0.1	..	..	..	..	..
— 24	Skjalfandi Bay	20	22.6	100	4	..	..	..	..	..	0.2	..	..	..	..	..
— 30	Langanes Flak	23	9.3	100	15	..	..	..	..	..	0.1	..	..	..	..	..
Sep. 2	Skagafjord	19	30.1	100	2	..	..	..	..	..	1	..	..	..	..	..
— 6	—	10	16.4	100	1	..	..	..	..	..	0.2	..	..	..	..	..
— 28	Skjalfandi Bay	20	12.6	100	0.1	..	..	..	..	..	0.2	..	..	..	..	..
1930																
July 1	East of Cape North	10	29.2	100	0.4	4	..	..	..	..	..	..	..	..	..	..
— 2	30 miles N.E. of Skagafj.	16	18.0	100	2	..	..	..	..	..	..	..	..	..	..	..
— 10	Skagafjord	12	34.2	100	1	2	..	..	..	..	..	..	..	..	..	..
— -	18 miles N.W. of Siglufj.	14	19.2	100	0.4	0.4	..	..	..	..	..	..	..	..	..	..
— 13	18 — — - —	17	18.2	100	0.4	0.2	..	..	..	..	..	..	..	..	..	..
— 18	Skagafjord	15	15.6	100	27	2	..	0.2	..	..	..	..	..	..	..	..
— 19	—	10	26.1	100	1	1	0.5	..	..	..	..	..	..	..	..	..
— -	Off Haganesvik	12	26.2	100	39	..	0.1	..	..	..	..	..	..	..	..	..
— 21	Skagafjord	10	35.0	100	25	0.1	1	0.1	..	..	..	..	..	..	..	..
— -	—	10	22.5	100	0.1	0.1	0.4	..	..	..	..	..	..	..	..	..
— 24	—	12	25.9	100	9	0.2	1	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	15	13.2	100	2	0.4	1	..	..	..	..	..	..	..	..	..
— 25	Olafsfjord	13	17.2	100	16	0.1	12	0.1	..	..	..	..	..	..	..	..
— -	Skagafjord	14	24.5	100	2	0.2	1	0.2	..	..	..	..	..	..	..	..
— -	Off Siglufjord	11	28.0	100	55	..	..	..	..	..	..	..	..	..	..	..
— -	Eyjafjord	15	15.1	100	6	0.2	26	..	..	..	..	..	..	..	..	..
— 27	—	11	28.1	100	18	..	..	..	..	..	0.1	..	..	..	..	..
— 29	Skagafjord	13	38.0	100	..	..	5	..	..	..	..	..	..	..	..	..
— 30	—	13	13.7	100	22	..	0.2	..	..	..	..	..	..	..	..	..
— 31	Melrakka Flak	10	41.2	100	..	0.2	..	..	..	..	..	..	..	..	..	..
— -	Skagafjord	12	39.8	100	0.2	..	14	..	..	..	..	..	..	..	..	..
— -	—	15	20.1	100	23	..	..	..	..	..	..	..	..	..	..	..
— -	—	8	32.5	100	..	..	11	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	13	15.3	100	3	..	..	..	..	..	..	..	..	..	2	..
Aug. 1	Skagafjord	10	9.5	100	0.4	..	1	..	..	..	..	..	..	..	..	..
— -	—	15	11.2	100	17	..	..	..	..	..	..	..	..	..	..	..

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1930																
Aug. 7	Eyjafjord	15	8.0	100	0.2	..	..	..	..	..	..	..	..	..	..	..
— -	Skagafjord	13	4.3	100	3	..	..	..	..	..	..	..	..	..	..	..
— 8	—	11	8.5	100	1	..	..	..	..	..	..	..	..	..	..	..
— -	—	15	9.2	100	4	0.1	..	..	..	..	..	..	..	..	..	..
— 10	Off Eyjafjord	16	9.1	97	48	0.1	..	..	..	..	..	..	..	..	..	..
— 11	Skagafjord	11	12.5	100	0.4	0.1	..	..	..	..	..	..	..	..	..	..
— -	—	15	9.4	100	29	0.2	0.1	..	..	..	..	..	..	..	..	..
— 12	—	15	15.8	100	26	..	..	..	..	..	..	..	..	..	..	..
— -	—	15	10.6	100	..	0.1	0.2	0.2	..	..	..	..	..	..	..	..
— -	—	12	5.8	100	22	0.2	0.1	..	..	..	..	..	..	..	..	..
— -	Eyjafjord	9	17.5	100	1	0.2	..	..	..	..	..	..	..	..	..	..
— 21	Huna Bay	16	15.6	97	2	0.1	..	..	..	..	..	..	..	..	..	..
— 23	—	21	17.0	100	2	..	..	..	..	..	..	..	..	..	..	..
— 26	10 miles N.E. of Siglufj.	12	29.3	100	42	0.3	..	..	..	..	..	..	..	..	..	..
— 27	Huna Bay	14	21.0	100	1	..	..	..	..	..	..	..	..	..	..	..
— 29	Off Langanes	11	10.0	100	0.4	..	..	..	..	..	..	..	..	..	..	..
— 30	8 miles N.W. of Grimsey	16	31.8	100	53	..	..	..	..	..	..	..	..	..	..	..
— 31	8 — — - —	15	25.2	87	52	..	..	..	..	..	..	..	..	..	..	..
— -	Off Langanes	11	8.9	100	1	..	..	..	..	..	..	..	..	..	..	..
Sep. 1	N.W. of Grimsey	9	8.7	100	0.5	..	..	..	..	..	..	..	..	..	..	..
— -	Off Langanes	11	10.7	100	2	0.2	..	..	..	..	..	..	..	..	..	..
— 2	Grimsey Flak	7	58.2	29	100	..	..	..	..	..	..	..	..	..	..	..
— -	Skagafjord	12	12.0	100	22	..	..	..	..	..	..	..	..	..	..	..
— -	20 miles N.N.E. of Grimsey	15	32.0	87	60	..	..	..	..	..	..	..	..	..	..	..
— 3	Skjalfandi Bay	11	10.8	100	5	0.1	..	..	..	..	..	..	..	..	..	..
— -	20 miles N.N.E. of Grimsey	15	30.8	82	100	..	..	..	..	..	..	..	..	..	..	..
— 7	Skjalfandi Bay	11	35.6	68	100	..	..	..	..	..	..	..	..	..	..	..
— 8	—	14	18.3	68	100	..	..	..	..	..	..	..	..	..	..	..
— 9	—	10	9.3	100	3	0.1	..	..	..	..	..	..	..	..	..	..
— 12	Melrakka Flak	10	45.3	29	100	..	..	..	..	..	..	..	..	..	..	..
— -	Off Axarfjord	10	35.5	28	100	..	..	..	..	..	..	..	..	..	..	..
1931																
July 7	Off Siglufjord	14	11.2	100	6	1	0.1	..	..	..	..	..	..	..	..	..
— 10	—	13	12.6	100	3	0.1	21	0.1	..	..	..	..	..	..	..	0.1
— 11	—	10	16.9	100	7	0.3	3	..	..	..	..	..	..	..	..	..
— 14	Huna Bay	14	6.0	100	82	0.1	..	..	0.4	..	..	..	..	..	..	0.3
- -	Off Skagafjord	13	6.8	92	75	0.1	..	..	..	..	..	..	..	..	..	..
— 15	Skagafjord	10	10.0	95	100	..	0.2	0.1	..	..	..	..	..	..	..	..
— 17	Huna Bay	11	6.5	100	57	0.2	..	..	..	..	..	..	..	..	..	..
— 19	Off Siglufjord	13	4.8	69	92	0.2	1	0.2	..	..	..	..	..	..	..	..
— -	- Skagafjord	16	5.7	100	62	0.1	0.3	..	..	..	..	0.1	..	..	..	0.1
— 20	Skagafjord	15	7.0	100	36	0.3	2	..	0.1	..	..	..	..	..	..	0.2
— -	—	15	6.8	100	63	0.2	1	0.1	..	..	..	..	..	..	..	0.1
— 21	Off Haganesvik	15	14.6	100	90	..	1	..	..	..	..	..	..	..	..	0.4
— -	Skagafjord	13	6.7	96	75	0.4	1	..	..	..	..	..	..	..	..	..
— 22	—	12	10.2	100	79	0.2	1	..	..	..	0.1	..	..	..	..	0.4
— -	—	15	9.4	97	90	0.1	1	0.3	0.1	..	..	..	..	..	..	0.2
— 26	—	14	7.8	93	84	0.1	0.2	0.1	0.4	..	0.1	..	..	..	..	0.4
— 27	—	16	11.3	91	100	0.2	0.4	0.1	0.1	..	0.1	..	..	..	..	0.2

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1931																
July 28	Skagafjord	15	8.6	100	75	0.4	0.1	..	..	..	0.1	..	..	..	..	..
— 30	Grimsey Flak	20	3.3	100	7	0.1	..	0.1	0.1	..	..	..	..	..	..	0.1
— -	Skjalfandi Bay	19	3.5	100	1	..	..	0.1	2	..	..	..	..	..	..	0.3
— 31	—	19	2.5	97	6	0.1	..	0.1	0.3	..	..	..	..	..	..	..
— -	—	15	2.6	97	8	..	..	..	..	..	..	..	..	..	..	..
Aug. 5	Off Siglufjord	19	5.4	100	20	..	..	..	0.4	..	..	..	..	..	..	0.1
— -	Grimsey Flak	17	6.4	97	48	0.2	..	..	..	..	0.1	..	..	..	..	0.1
— 7	Off Skagafjord	11	13.9	100	1	0.1	..	..	0.1	..	..	..	..	..	..	0.1
— 9	—	16	8.1	100	0.2	..	..	..	0.4	..	..	..	..	..	..	0.1
— -	18 miles N. of Skagi	11	19.6	100	0.4	0.1	0.1	..	0.4	..	..	..	..	..	..	0.1
— 10	Off Skagafjord	14	17.5	100	0.1	..	..	..	..	..	..	..	..	..	..	..
— 12	Huna Bay	13	10.4	100	0.1	..	..	..	..	..	..	..	..	..	..	..
— 13	Off Haganesvik	16	7.0	100	0.1	..	..	..	0.5	..	..	0.5	..	..	..	0.1
— 21	Skjalfandi Bay	13	8.3	100	..	..	..	..	..	..	0.1	1	..	..	..	..
— -	Eyjafjord	11	17.4	100	0.2	0.1	..	..	..	..	..	0.3	..	..	..	..
— 28	Skagafjord	13	7.4	100	0.3	..	..	..	..	..	..	1	..	..	..	..
— -	Off Eyjafjord	11	9.6	100	0.5	0.1	..	0.5	..	..	..	0.5	..	..	..	..
— 29	- Siglufjord	15	12.5	100	0.3	..	..	..	..	..	..	..	..	..	..	..
— -	- —	14	11.5	100	1	..	..	..	..	..	..	..	..	..	..	..
Sep. 6	- Eyjafjord	12	11.0	100	0.2	..	..	..	..	..	..	..	..	..	..	..
— -	- —	10	13.9	100	1	..	..	..	..	..	..	1	..	..	..	..
— 11	Eyjafjord	13	14.3	100	1	0.1	..	..	..	..	..	0.4	..	12	..	..

B. Herring caught in drift net.

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1927																
Aug. 4	24 miles N.E. of Siglufj.	19	1.1	0.1	52	1	..	..	..	..	..	..	..	..	..	..
— 5	24 — N.N.W. — ..	16	1.5	6	46	0.4	..	..	..	..	..	..	..	..	..	..
— 18	11 — N.E. of Siglufj.	18	8.7	70	47	0.1	..	..	..	..	6	..	..	..	..	..
— -	Grimsey Flak	20	3.8	78	16	0.1	..	..	..	..	8	..	..	..	..	..
— -	—	15	2.6	57	11	..	..	..	..	..	4	..	..	..	..	..
— 19	19 miles N.E. of Siglufj.	12	4.8	79	15	0.3	..	..	..	..	17	..	..	..	..	..
— -	- — — — ..	13	10.2	93	19	..	..	..	..	..	12	..	..	..	..	..
— -	18 — — — ..	11	2.5	70	10	0.5	..	..	..	..	11	..	..	..	..	..
— -	- — — — ..	13	3.5	100	9	1	..	..	..	..	12	..	..	..	..	..
— -	- — — — ..	14	3.7	95	28	0.2	..	..	..	..	6	..	..	..	..	..
— -	Eyjafjord	15	4.3	22	30	..	..	..	..	..	1	..	..	..	..	..
— 20	N.E. of Siglufjord	15	2.1	49	8	..	..	..	..	..	5	..	..	..	..	..
— -	— —	15	1.7	33	12	..	..	..	..	..	9	..	..	..	..	..
— 24	16 miles N.E. of Siglufj.	20	2.2	62	15	0.1	..	..	..	..	36	..	..	..	..	..
— 25	12 — — — ..	15	4.4	78	19	0.5	..	..	..	..	6	..	..	..	..	..
— 30	Grimsey Flak	20	0.8	5	6	..	..	..	..	..	2	..	..	..	..	..

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1927																
Sep. 1	32 miles N.N.E. of Siglufj.	10	2.3	40	..	..	..	..	..	..	18	..	..	..	..	..
— -	13 — — —	10	4.0	80	1	..	..	..	..	..	50	..	..	..	..	..
— 7	20 — N.E. —	11	7.7	91	46	1	..	..	..	..	2	..	..	..	..	..
— 10	30 — — —	14	2.0	38	5	7	..	..	..	..	7	..	..	..	..	..
1930																
June 21	Huna Bay	14	10.0	100	0.3	0.1	..	..	0.2	..	..	..	0.1	..	..	..
— 23	—	15	31.9	97	23	0.1	..	..	..	..	..	..	..	..	..	..
— 24	—	12	30.5	90	14	..	..	..	..	..	..	..	0.1	..	..	..
— -	—	16	24.8	94	6	0.1	..	..	..	..	..	..	..	..	..	..
— 25	60 miles N. of Siglufjord .	12	15.2	100	3	1	..	..	..	..	..	..	..	..	..	..
— 26	Off Eyjafjord	13	33.3	100	19	3	1	2	0.2	..	..	..	..	..	..	..
— -	9 miles N.E. of Siglufjord.	10	7.8	85	0.2	..	..	..	0.1	..	..	..	..	..	..	..
— 29	7 — — —	12	24.8	85	19	0.1	..	..	..	..	..	..	..	..	..	..
July 16	20 — — —	10	8.7	100	1	1	5	..	..	..	..	..	..	..	0.1	..
— 21	Off Siglufjord	13	14.3	75	13	0.4	..	..	..	..	..	..	0.1	..	..	..
— 23	18 miles N.E. of Siglufj...	12	12.9	100	1	1	0.1	..	..	..	..	..	..	..	..	..
— 24	Off Siglufjord	15	7.0	80	12	0.3	..	..	..	..	..	..	..	..	..	..
— 25	25 miles N.E. of Siglufj...	15	7.8	93	16	1	..	..	..	..	..	..	..	..	..	..
— 28	12 — N. — ..	11	10.7	100	1	1	..	..	..	..	..	..	..	..	0.1	..
— 29	12 — N.E. — ..	15	2.6	72	13	0.1	..	..	..	..	..	..	..	..	0.1	..
— -	Eyjafjord	16	8.2	91	4	0.4	..	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	13	4.7	100	9	0.1	..	..	..	..	..	..	..	..	0.2	..
— 30	15 miles N.E. of Siglufj...	12	7.5	92	4	0.5	..	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	12	2.5	60	11	..	2	..	..	..	..	..	..	..	..	..
— 31	Off Siglufjord	10	3.9	85	11	0.3	..	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	10	6.3	92	21	..	..	..	..	..	..	..	..	..	..	..
Aug. 1	7 miles N.E. of Siglufjord.	17	4.2	87	15	0.1	..	..	..	..	..	..	..	..	..	..
— -	10 — E.N.E. —	10	5.0	19	19	0.2	0.1	..	..	..	..	..	..	..	..	..
— -	14 — N. —	15	4.8	59	9	..	..	..	..	..	..	..	..	..	..	..
— 2	14 — N.E. —	14	3.7	82	19	0.3	0.1	..	..	..	..	..	0.1	..	0.1	..
— -	17 — N. —	10	5.7	95	7	0.1	..	..	..	..	..	..	..	..	..	..
— 4	10 — - —	12	1.9	32	6	3	..	..	..	..	..	..	..	..	..	..
— 5	Eyjafjord	12	1.2	79	16	..	..	..	..	..	..	..	..	..	..	..
— 7	Off Eyjafjord	16	6.2	58	57	..	..	..	..	..	..	..	..	..	..	..
— 11	Off Siglufjord	10	5.7	100	24	..	..	..	..	..	..	..	..	..	..	..
— 14	—	12	5.0	69	17	0.1	..	..	..	..	..	..	..	..	..	..
— 26	Eyjafjord	14	4.1	17	21	0.1	..	..	..	..	..	..	..	..	..	..
1931																
June 19	Off Eyjafjord	8	24.2	..	69	5	..	..	..	..	..	..	..	..	..	..
— 30	12 miles N.E. of Siglufj...	9	11.0	84	4	1	..	..	..	..	..	..	..	..	0.2	..
— -	21 — N. — ..	11	24.1	100	1	2	..	..	..	..	..	..	..	..	..	..
July 1	12 — N.N.E. — ..	11	16.0	82	12	0.2	..	..	..	..	..	..	..	..	..	..
— 2	14 — N.E. — ..	11	14.3	82	7	1	..	..	..	..	..	..	..	..	..	..
— 7	16 — — — ..	11	9.4	100	1	0.1	..	..	..	..	..	..	..	..	0.1	..
— 8	11 — E.N.E. — ..	11	6.1	73	3	0.5	5	..	..	..	..	..	..	..	..	..
— 14	12 — N.E. — ..	11	4.7	91	3	0.1	0.1	..	..	..	..	..	..	..	..	..
— 15	12 — — — ..	15	5.3	100	1	0.1	0.5	..	..	..	..	..	..	..	..	..
— -	10 — — — ..	11	4.5	91	2	0.2	1	..	..	..	..	..	..	..	..	..

Date	Position	No. of herring	Average volume of stomach content cc.	Mean values of frequency												
				Copepods	Euphausids	Amphipods	Crab larvae	Other decapods	Cirripede larvae	Cladocerans	Pteropods	Gastropods	Polychaetes	Chaetognaths	Fish	Fish ova
1931																
July 16	10 miles N.E. of Siglufj. . .	11	4.0	82	4	0.2	0.1	..	..	..	..	..	..	..	..	..
— 17	12 — — — ..	13	1.2	9	9	1	..	..	0.1	..	..	..	..	..	..	..
— -	14 — — — ..	11	1.8	46	20	..	..	..	..	..	..	..	..	..	..	..
— 18	Off Eyjafjord	11	4.0	18	14	..	9	..	..	..	..	..	..	..	..	..
— 19	14 miles N.N.E. of Siglufj.	13	1.8	40	14	0.2	..	..	..	..	..	..	..	..	..	..
— 20	10 — N.E. —	15	1.9	24	17	0.1	0.1	0.1	0.2	..	..	..	..	..	..	0.2
— 22	14 — — —	12	1.0	6	11	..	..	0.1	..	..	..	..	..	..	..	0.2
— 27	Eyjafjord . . :	15	2.1	7	35	0.3	0.1	0.2	..	..	..	..	..	..	..	0.2
— 29	8 miles E.N.E. of Siglufj. .	12	1.1	14	9	0.1	..	..	..	..	..	..	..	..	..	..
— -	Off Eyjafjord	12	0.8	1	4	0.1	..	..	..	..	..	..	..	..	0.2	..
— 30	9 miles E. of Siglufjord. . .	12	2.7	6	26	0.1	..	..	..	..	..	..	..	8	..	0.2
— -	8 — N.E. — . . .	12	1.1	1	15	0.1	..	..	..	..	..	..	..	..	..	0.2
Aug. 1	Off Eyjafjord	14	1.3	6	10	..	..	..	0.1	..	..	..	..	..	0.1	..
— -	15 miles N. of Siglufjord .	11	2.7	6	22	3	..	0.5	0.1	..	..	0.1	..	..	0.1	0.1
— -	8 — N.E. — .	13	3.1	15	57	0.2	..	..	1	0.5	..	..	..	..	..	..
— 2	Skjalfandi Bay	12	1.0	5	1	..	..	..	..	..	..	..	..	..	..	..
— 3	10 miles N.E. of Siglufj. . .	14	2.0	3	51	..	..	..	..	..	..	..	..	..	..	..
— -	8 — — — ..	11	1.2	7	46	..	..	..	..	..	0.1	..	..	..	..	..
— 5	8 — N.W. — ..	12	3.5	3	81	..	..	..	1	1	..	..	..	0.1	..	..
— 7	12 — N.E. — ..	10	4.5	12	95	..	..	..	..	..	..	..	..	..	..	0.1
— -	15 — N. — ..	12	3.8	28	69	0.1	..	..	..	2	..	..	..	..	..	..
— -	6 — E.N.E. — ..	10	6.7	2	82	0.3	..	..	0.2	..	..	..	..	..	..	..
— 14	20 — N. — ..	14	4.5	27	25	0.1	..	..	..	..	..	..	..	..	..	0.1
— -	18 — N.E. — ..	14	6.2	93	14	0.1	..	..	..	..	..	0.1	..	0.1	..	..
— 15	23 — N.W. — ..	12	3.8	92	7	0.1	..	..	0.1	..	..	..	..	..	..	..
— 16	Grimsey Flak	12	8.5	23	48	..	..	..	..	..	..	..	..	..	..	..
— 19	16 miles N.E. of Siglufj. . .	15	5.7	97	13	0.1	..	..	0.2	..	0.2	0.1	..	..	..	..
— -	21 — — — ..	14	5.6	95	14	0.1	..	..	..	..	0.1	..	..	..	..	..
— 20	13 — — — ..	15	5.0	100	7	..	..	..	..	..	..	0.1	..	..	..	..
— -	18 — — — ..	13	6.0	85	8	..	..	..	..	..	0.1	..	..	..	..	..
— 22	16 — — — ..	11	4.0	100	3	0.1	..	..	..	..	0.3	..	..	..	..	..
— 24	14 — — — ..	15	6.2	93	4	..	..	..	..	..	0.2	..	..	..	..	..
— 25	11 — — — ..	14	3.6	89	2	..	..	..	..	..	2	..	..	..	..	..
— -	16 — — — ..	13	3.9	88	5	..	..	..	..	..	0.2	..	..	..	..	..
— 27	22 — — — ..	11	5.5	100	2	0.1	..	..	..	..	..	..	..	..	0.5	..
— -	15 — — — ..	14	5.7	100	3	0.1	..	..	..	..	0.1	..	..	..	..	..
— -	18 — E.N.E. — ..	14	4.8	100	5	..	..	..	..	..	..	0.2	..	0.1	..	..
Sep. 3	23 — N.E. — ..	10	1.0	9	5	0.1	..	..	..	..	0.2	..	..	..	..	..
— 12	21 — — — ..	12	0.5	1	1	0.2	..	..	..	..	..	..	..	..	0.1	..

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